AREA STRUCTURE PLAN
FOR NORTH PIGEON LAKE, LEDUC COUNTY

ENVIRONMENTAL ASSESSMENT

Submitted to:
County of Leduc, Alberta

Submitted by:
Bruce Thompson & Associates Inc.
Edmonton, Alberta

SEPTEMBER 2009
# TABLE OF CONTENTS

1.0 INTRODUCTION ............................................................................................................... 1  
   1.1 BACKGROUND ........................................................................................................... 1  
   1.2 OBJECTIVES AND SCOPE ...................................................................................... 1  
   1.3 LOCATION .............................................................................................................. 2  
   1.4 PLANNING HISTORY AND PREVIOUS ASSESSMENTS ........................................ 10  

2.0 APPROACH AND METHODS .......................................................................................... 11  

3.0 DESCRIPTION OF EXISTING ENVIRONMENTAL FEATURES ..................................... 18  
   3.1 HISTORY OF PIGEON LAKE ................................................................................. 18  
   3.2 ECOLOGICAL SETTING ....................................................................................... 18  
   3.3 GEOLOGY AND SOILS ......................................................................................... 19  
   3.4 SURFACE WATER ................................................................................................. 21  
   3.5 GROUNDWATER .................................................................................................... 32  
   3.6 VEGETATION COMMUNITIES ............................................................................... 36  
   3.7 WILDLIFE AND WILDLIFE HABITAT ................................................................. 83  
   3.8 FISH AND AQUATIC SYSTEMS ............................................................................ 89  
   3.9 BIODIVERSITY AND RARE SPECIES .................................................................. 92  
   3.10 ENVIRONMENTAL AND MUNICIPAL RESERVES, PARKS, TRAILS AND NATURAL AREAS .......................................................... 95  

4.0 POTENTIAL ENVIRONMENTAL EFFECTS ................................................................. 96  
   4.1 HUMAN ACTIVITIES AND THE NATURAL ENVIRONMENT ................................... 96  
   4.2 DISCUSSION OF ENVIRONMENTAL EFFECTS .................................................... 103  

5.0 RECOMMENDATIONS .................................................................................................. 106  
   5.1 GENERAL AREA STRUCTURE PLAN POLICIES ................................................. 106  
   5.2 CONSERVATION OF SPECIAL AREAS ............................................................... 111  

6.0 REFERENCES .............................................................................................................. 116
7.0 LIMITATIONS .................................................................................................118

8.0 LIST OF APPENDICES ..................................................................................119

APPENDIX A: LISTS OF PLANT SPECIES AND WILDLIFE OBSERVED AT
THE HUTCHINSON CONSERVATION EASEMENT, 2001-2005 ...... A-1

APPENDIX B: WAYPOINT COORDINATES ...................................................... B-1

APPENDIX C: ANHIC REPORT ........................................................................ C-1

APPENDIX D: HISTORICAL AERIAL PHOTOGRAPHS .................................. D-1
## List of Figures

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Fig No.</th>
<th>Caption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.1</td>
<td>The location of the North Pigeon Lake ASP study area.</td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>North Pigeon Lake ASP study area, showing LSD designations.</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td>Aerial orthophotograph of the North Pigeon Lake ASP study area, showing boundary (yellow line).</td>
</tr>
<tr>
<td></td>
<td>1.4</td>
<td>Topographical map of the North Pigeon Lake ASP study area: east side.</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>Topographical map of the North Pigeon Lake ASP study area: west side.</td>
</tr>
<tr>
<td></td>
<td>1.6</td>
<td>Aerial photograph taken in 2005 of the North Pigeon Lake ASP study area: east side.</td>
</tr>
<tr>
<td></td>
<td>1.7</td>
<td>Aerial photograph taken in 2005 of the North Pigeon Lake ASP study area: west side.</td>
</tr>
<tr>
<td>2</td>
<td>2.1</td>
<td>Waypoints map: east part of study area (see Appendix B for more detail).</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>Waypoints map: centre of study area (see Appendix B for more detail).</td>
</tr>
<tr>
<td></td>
<td>2.3</td>
<td>Waypoints map: west part of study area (see Appendix B for more detail).</td>
</tr>
<tr>
<td></td>
<td>2.4</td>
<td>Focus points (east side of study area).</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>Focus points (west side of study area).</td>
</tr>
<tr>
<td>3</td>
<td>3.1</td>
<td>Bedrock Geology of Leduc County (from Hydrogeological Consultants Ltd., 1999).</td>
</tr>
<tr>
<td></td>
<td>3.2</td>
<td>Distribution of agricultural lands of different capability for agriculture (Canada Land Inventory, 1972, in Knapik and Westworth, 1984).</td>
</tr>
<tr>
<td></td>
<td>3.3</td>
<td>The watercourses, major wetlands, peatlands and riparian areas in the North Pigeon Lake ASP area.</td>
</tr>
<tr>
<td></td>
<td>3.4</td>
<td>Total dissolved solids in groundwater from surficial deposits (from Hydrogeological Consultants Ltd., 1999).</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>Summer precipitation vs. water levels in AEP Obs WW No. 320 (from Hydrogeological Consultants Ltd., 1999).</td>
</tr>
<tr>
<td></td>
<td>3.6</td>
<td>Recharge/discharge areas between surficial deposits and upper bedrock aquifer(s) (from Hydrogeological Consultants Ltd., 1999).</td>
</tr>
<tr>
<td></td>
<td>3.7</td>
<td>The distribution of vegetation communities in the North Pigeon Lake ASP area.</td>
</tr>
<tr>
<td></td>
<td>3.8</td>
<td>Focus sites observed in the field studies, August/September 2009 (east side of study area).</td>
</tr>
<tr>
<td></td>
<td>3.9</td>
<td>Focus sites observed in the field studies, August/September 2009 (west side of study area).</td>
</tr>
<tr>
<td></td>
<td>3.10</td>
<td>Wildlife habitat regions of Leduc County (from Knapik and Westworth, 1984).</td>
</tr>
<tr>
<td></td>
<td>3.11</td>
<td>Excerpt from the fish habitat map for the Alberta Code of Practice for Watercourse Crossings and the Code of Practice for Outfall Structures (Alberta Environment, 2007).</td>
</tr>
</tbody>
</table>
List of Figures (cont’d)

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Table #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4.1</td>
<td>Oil and gas pipelines in the North Pigeon Lake ASP area (County of Leduc).</td>
</tr>
<tr>
<td></td>
<td>4.2A</td>
<td>The current distribution of population in the EAST part of the North Pigeon Lake ASP area (red dots indicate human residences) (County of Leduc).</td>
</tr>
<tr>
<td></td>
<td>4.2B</td>
<td>The current distribution of population in the WEST part of the North Pigeon Lake ASP area (red dots indicate human residences) (County of Leduc).</td>
</tr>
<tr>
<td>6</td>
<td>6.1</td>
<td>Sensitive lands (wetland, peatland and riparian areas) in the North Pigeon Lake ASP area.</td>
</tr>
<tr>
<td></td>
<td>6.2</td>
<td>Ecological connectivity: major blocks of forested areas in the North Pigeon Lake ASP area.</td>
</tr>
<tr>
<td></td>
<td>6.3</td>
<td>Major core blocks of forested area and sensitive areas in the North Pigeon Lake ASP area.</td>
</tr>
<tr>
<td>Appendix</td>
<td>B1</td>
<td>Detailed waypoints map: east part of study area.</td>
</tr>
<tr>
<td>Appendix</td>
<td>B2</td>
<td>Detailed waypoints map: west part of study area.</td>
</tr>
<tr>
<td>Appendix</td>
<td>C1</td>
<td>Area of investigation for listed species, provided by ANHIC (Alberta Natural History Information Centre), September 2009.</td>
</tr>
</tbody>
</table>

List of Appendices

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Lists of plant species and wildlife observed at the Hutchinson Conservation Easement, 2001-2005.</td>
</tr>
<tr>
<td>B</td>
<td>Waypoint coordinates.</td>
</tr>
<tr>
<td>C</td>
<td>ANHIC Report.</td>
</tr>
<tr>
<td>D</td>
<td>Historical aerial photographs of the North Pigeon Lake ASP area.</td>
</tr>
</tbody>
</table>

List of Tables

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Table #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3.1</td>
<td>The physical parameters of Pigeon Lake (Mitchell and Prepas (1990), as quoted in Aquality (2008)).</td>
</tr>
<tr>
<td></td>
<td>3.2</td>
<td>Major ions and related water quality variables for Pigeon Lake. (Alberta Environment unpublished data, Naquadat station 01AL05FA1500).</td>
</tr>
<tr>
<td></td>
<td>3.3</td>
<td>Common and scientific names of birds observed/expected to breed or otherwise use the North Pigeon Lake ASP area.</td>
</tr>
<tr>
<td></td>
<td>3.4</td>
<td>Listed species that have been reported in the North Pigeon Lake ASP area (+2 km) (ANHIC, 2009).</td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td>Sensitive species whose distribution overlaps with the North Pigeon Lake ASP study area.</td>
</tr>
<tr>
<td>4</td>
<td>4.1</td>
<td>Population demographics of communities on the shore of Pigeon Lake (Statistics Canada, 2006).</td>
</tr>
<tr>
<td></td>
<td>4.2</td>
<td>Number of sewage facilities installed since 2000 in the North Pigeon Lake ASP area.</td>
</tr>
</tbody>
</table>
NORTH PIGEON LAKE AREA STRUCTURE PLAN
ENVIRONMENTAL ASSESSMENT

1.0 INTRODUCTION

1.1 BACKGROUND

The North Pigeon Lake Area Structure Plan (ASP) is to be a long-range plan with a 25 year planning horizon. It will provide a policy framework to manage growth and land uses around the north side of Pigeon Lake, Alberta, and will address a number of issues affecting the watershed, as defined by Pigeon Lake stakeholders. Best practices will be identified in the Plan to assist landowners and the County in making long-term land use decisions.

The intent of the Plan is to suggest suitable land uses (i.e., residential, recreation, park and open space, community, commercial, and mixed land uses) that will create a vibrant and sustainable community while protecting the watershed environment. The Plan will address connectivity of the natural spaces and trails, recreational access and linkages, passive recreation opportunities, integrated water and waste water management, and the management of open spaces and land uses. In addition, the Plan will recommend current and long-term land uses, servicing standards appropriate for the use intended, and prioritize the protection of park, open space, and environmentally sensitive areas.

The Environmental Assessment is one component of several that will form the basis of developing the ASP (e.g., hydrological, hydrogeological, geotechnical, aquatic environment and infrastructure studies).

1.2 OBJECTIVES AND SCOPE

The objectives of the Environmental Assessment component are as follows:

- To identify and provide a general overview evaluating existing ecological features within the North Pigeon Lake ASP area, as they appear at the present time;
- To provide practical recommendations for preserving or enhancing ecologically significant features within the context of the ASP; and
- To provide general recommendations for mitigation of potential adverse environmental effects resulting from development, within the ASP area.

The geographical scope of the Assessment is the North Pigeon Lake ASP area, as shown in other documents associated with the ASP development.

While the Environmental Assessment considers, in a general way, the potential for existing contamination from present or past activities, it should not be intended to constitute a Phase 1 Environmental Site Assessment, which would be considerably more detailed and would access several more sources of information (e.g., land titles, aerial photos, enquiries from...
regulatory bodies and site-specific field reconnaissance). The possibilities for risk from contamination herein are made strictly on the basis of incidental information arising during the field reconnaissance, discussions with residents of the area, or discussions with government bodies. No actual database searches have been conducted with this intent, as part of the work program.

1.3 LOCATION

The area of interest is a large area adjacent to the north end of Pigeon Lake, in Leduc County. The ASP study area is located as shown in Fig. 1.1. The particular sections that are in the study include:

- S2-S6 of Township 48-1-5
- S1-6 of Township 48-2-5
- S1-2 of Township 48-3-5
- S24, 25, 36 of Township 47-3-5
- S14 of Township 47-2-5
- S19-36 of Township 47-2-5
- S14-15 of Township 47-1-5
- S23-35 of Township 47-1-5.

An aerial orthophotograph of the ASP area is shown in Fig. 1.2.
Fig. 1.1: The location of the North Pigeon Lake ASP planning area.
Fig. 1.2: North Pigeon Lake ASP study area, showing LSD designations.
Fig. 1.3: Aerial orthophotograph of the North Pigeon Lake ASP planning area, showing boundary (yellow line).
Fig. 1.4: Topographical map of the North Pigeon Lake ASP study area: east side.
Fig. 1.5: Topographical map of the North Pigeon Lake ASP study area: west side.
**Fig. 1.6:** Aerial photograph taken in 2005 of the North Pigeon Lake ASP study area: east side.
Fig. 1.7: Aerial photograph taken in 2005 of the North Pigeon Lake ASP study area: west side.
1.4 PLANNING HISTORY AND PREVIOUS ASSESSMENTS

A number of planning and scientific documents were available that are relevant to the environmental assessment. Most were produced by or on behalf of the County of Leduc.

- Leduc County Corporate Goals
- Leduc County Land Use Bylaw (LUB)
- Leduc County Municipal Development Plan (MDP)
- Leduc County Parks and Open Spaces Master Plan
- Leduc County, Pigeon Lake Watershed Management Plan.

While they were not necessarily focusing on the same study area, the studies overlapped it to some extent, and this report will summarize the relevant findings from these existing sources.

Various other planning and environmental initiatives have been carried out by Leduc County departments to reclaim public lands, protect sensitive areas, and limit development and subdivision of good quality agricultural lands. Faced with increasing demands from recreational, urban, and rural residential land uses, environmentally sensitive areas are receiving special consideration for conservation. Efforts in this field are ongoing as environmental concerns gain greater public importance. The corresponding vision statement from the Intermunicipal Development Plan (2009) states that: “...Leduc County continue to support initiatives that promote good environmental management, conservation and enhancement.
2.0 APPROACH AND METHODS

The environmental assessment was conducted to describe and interpret site features as they existed in August/September 2009.

The information was obtained by site reconnaissance of the North Pigeon Lake ASP area in a broad fashion, and then focusing on sites within the ASP area that appeared to have special vegetation, wildlife or other features, or which would be likely to have sensitivity to disturbance.

Consultations were also conducted, either in person or by telephone, with people who lived or had property in the North Pigeon Lake ASP area. The people who were spoken to were those whose names had been provided by the County of Leduc as being willing to provide their views. We were somewhat limited by the fact that only about 12 landowners agreed to participate in interviews. Further limitation was experienced in the fact that we could not access many areas of the ASP zone because landowner consent was not offered.

Previous reports for Leduc County were also reviewed, including those on water, wildlife, hydrogeology, history and other relevant matters.

The site reconnaissance took place in July-September, 2009, on the following days:

- July 29
- August 7
- August 21
- August 26
- September 4
- September 11
- September 18

In addition, maps and historical aerial photographs were examined, to assess surrounding and use, vegetation areas, developments, and so forth.

The scope of the field reconnaissance was to observe features of vegetation, drainage, wildlife and other components of the natural environment, as it existed at the times of the field reconnaissance. The types and distribution of vegetation, the type of forest, drainage features, wildlife and wildlife signs (e.g., tracks, feces, hair, burrows, nests, rubs, scrapes, etc.), and any other environmental features, were noted by location and documented with photographs.

Locations and features of the land and the shore were geolocated using a Garmin GPS60c hand-held GPS unit. The coordinates of all waypoints are given in Appendix B. Figs. 2.1, 2.2 and 2.3 show, respectively, the waypoints established in the study area for the east, west and centre portions. Thirty “focus” sites were viewed in relative detail, based upon their apparent importance to wildlife, waterbodies or sensitivity (see chapter on vegetation). The locations of these sites are shown in Figs. 2.4 and 2.5 (blue numbered dots).

Historical aerial photos were examined from the years 1949, 1962, 1981 and 2001, to reveal trends and changes in the vegetation patterns, waterbodies and so forth.
Peatlands (bogs, fens) and other wetlands were identified by observing the vegetation growing there, and by examining the corresponding patterns on the aerial historic photographs.

Classification of wetland areas was done according to the Stewart and Kantrud Wetland Classification System (Stewart and Kantrud, 1971). The criteria used to make these identifications were based on plant species that occur in this region. The historical aerial photographs were examined to determine the configuration of each low, wet area and the amount of surface water present.

GPS Waypoints are specific locations established by the GPS instrument, abbreviated in this report at “WP”, so that Waypoint 8, for example, is referred to as “WP08”. 
Fig. 2.1: Waypoints map: east part of study area (see Appendix B for more detail).
Fig. 2.2:  Waypoints map: centre of study area (see Appendix B for more detail).
Fig. 2.3: Waypoints map: west part of study area (see Appendix B for more detail).
Fig. 2.4:  Focus points (east side of study area).
Fig. 2.5: Focus points (west side of study area).
3.0 DESCRIPTION OF EXISTING ENVIRONMENTAL FEATURES

3.1 HISTORY OF PIGEON LAKE

Earlier known as Woodpecker Lake (which is a translation from the Cree name Hmi-hmoo (Mitchell and Prepas, 1990), Pigeon Lake was re-named as such in 1858, probably due to the flocks of Passenger Pigeons in the vicinity of the lake (Mitchell and Prepas, 1990; as quoted by Aquality, 2008). The Lake was a gathering place for Aboriginal peoples and the missionaries who were attempting to convert them to Christianity. In 1847, Reverend Robert Rundle received permission to establish a mission on Pigeon Lake from the Hudson’s Bay Co. and the Wesleyan Missionary Society. Rundle was responsible for translating hymns and biblical scriptures into Cree. At the time, there was also a Hudson’s Bay Co. post at the lake, as well as a number of agricultural enterprises fostered by the mission. Rundle sought to help the Aboriginal people around him survive in the face of incoming European settlement. In 1965, Rundle’s Mission was dedicated as a National Historic Monument. Rundle’s Mission is now held by the Government of Alberta and managed by the non-profit Rundle Mission Society.

3.2 ECOLOGICAL SETTING

The County of Leduc lies within two Natural Regions/Subregions of Alberta: the Dry Mixedwood Subregion of the Boreal Forest Natural Region and the Central Parkland Subregion of the Parkland Natural Region. Pigeon Lake, and the North Pigeon Lake ASP planning area lies within the Dry Mixedwood Subregion (Alberta Environment, 1998).

The vegetation of the Dry Mixedwood sub-region is transitional between the Central Parkland and Central Mixedwood sub-regions, and there are community types common to all three. Trembling aspen (Populus tremuloides) is an important species in all three sub-regions, occurring in both pure and mixed stands. Balsam poplar (Populus balsamifera) frequently occurs with aspen especially on moister sites in depressions and along streams. Coniferous species are more common further north in the Dry Mixedwood sub-region with mixed stands of aspen and white spruce being widespread. Dry, sandy upland sites are usually occupied by Jack Pine (Pinus banksiana) forests. Peatlands are common throughout the sub-region and are extensive in some areas.

Two major forest types are prevalent in the Central Parkland sub-region, i.e., one dominated by trembling aspen (drier sites), and one dominated by balsam poplar on moister sites in depressions and in the northern part of the subregion. Both are characterized by a diverse understory. Species characteristic of the aspen forest type include snowberry (Symphoricarpos albus), saskatoon (Amelanchier alnifolia), beaked hazel (Corylus cornuta), choke cherry (Prunus virginiana), bunchberry (Cornus canadensis), wild lily-of-the-valley (Maianthemum canadense) and false melic grass (Schizachne purpurascens).

In the moister (poplar dominated) areas, the understory is very diverse, consisting of such plants as red osier dogwood (Cornus stolonifera), pussy willow (Salix discolor), northern gooseberry (Ribes oxycanthis), green alder (Alnus crispa), bracted honeysuckle (Lonicera involucrata), bluebells (Mertensia paniculata), palmate-leaved coltsfoot (Petasites palmarum), Bishop’s cap (Mitella nuda) and baneberry (Actaea rubra). Species common to
both types include wild rose (Rosa acicularis), woods rose (Rosa woodsii), low-bush cranberry (Viburnum edule), wild red raspberry (Rubus idaeus), dewberry (Rubus pubescens), twining honeysuckle (Lonicera dioica), wild sarsaparilla (Aralia nudicaulis), bearded wheat grass (Agropyron trachycaulum), fairy bells (Disporum trachycarpum), pink wintergreen (Pyrola asarifolia), Lindley's aster (Aster ciliolatus), northern bedstraw (Galium boreale), fireweed (Epilobium angustifolium), creamy peavine (Lathyrus ochroleucus), American vetch (Vicia americana), and star-flowered Solomon's seal (Smilacina stellata).

Within the Dry Mixedwood Sub-region in Leduc County, there are several wildlife habitat regions/subregions, as defined by Knapik and Westworth, 1984. The North Pigeon Lake ASP planning area comprises the Pigeon Lake Uplands wildlife habitat subregion.

### 3.3 GEOLOGY AND SOILS

#### 3.3.1 Geology

![Figure 16. Bedrock Geology](image)

**Fig. 3.1**: Bedrock Geology of Leduc County (from Hydrogeological Consultants Ltd., 1999).
The upper bedrock in the county is the Paskapoo formation and the Edmonton Group. The Paskapoo Formation consists of cycles of thick, tabular sandstones, siltstone and mudstone layers. The Edmonton group consists of fresh and brackish-water deposits of fine grained sandstone and silty shale, thick coal seams, and numerous bentonite beds. The thickness of the Paskapoo formation is from zero to 200 m in Leduc County. The thickness of the Edmonton group varies from 400 to 480 m. The Paskapoo Formation is the upper bedrock, and it subcrops in the southwestern quarter of the county. In Central Alberta it contains the Dalehurst, Lacombe and Haynes members. The North pigeon Lake study area is underlain by the Lacombe Member, which has a maximum thickness of 140 m. It has upper and lower components. The Upper Lacombe Member is mainly composed of shale interbedded with sandstone and has a maximum thickness of 70 m. The Lower Lacombe member, which has a maximum thickness of 70 m, is composed of sandstone and coal layers (Hydrogeological Consultants Ltd., 1999).

3.3.2 Soils

Soils of the Dry Mixedwood Boreal Forest are typically gray luvisols in well-drained, upland till sites and eutric brunisols in coarse-textured sandy uplands. Organics and gleysolics occur on wet depressional sites.

The Pigeon Lake Uplands subregion is characterized by a moderately hummocky morainal landform with some thin till veneer over soft bedrock. Dominant soils in the subregion are Orthic Gray Luvisols with some Organics. Most of the area is used as forage pasture, with some annual cropping. The topography and climate result in severe limitations to agriculture. There are many wetlands, primarily bogs and fens, in the area (Westworth and Associates, 1990).

Most of the lands in the ASP area are classified as Class 3 for agricultural potential (moderately severe limitations that restrict the range of crops or require special conservation practices). Some of the land in the northwest of the area, and around the west shore of Pigeon Lake, is classified as Class 4-7 (severe limitations).

The soils of the area will be addressed in another component of the North Pigeon Lake ASP study, so this is not discussed in further detail here.
3.4 SURFACE WATER

3.4.1 Overview of the Watershed

The Pigeon Lake watershed lies within the Battle River Watershed which in turn is located in the North Saskatchewan River Basin. It has a drainage area of 187 km² (Mitchell and Prepas, 1990). Pigeon Lake has a surface area of 96.7 km², which represents about 52% of the drainage area. The lake has a mean depth of 6.2 m and a maximum depth of 9.1 m. Pigeon Lake, as will be discussed later in this report, has had a chronic problem with an over-abundance of nutrients including nitrogen and phosphorus compounds. In general, relatively shallow lakes with large drainage areas compared to lake area generally have more algal growth than lakes with smaller drainage basins (Alberta Environment, 1989). Although Pigeon Lake has a relatively small drainage area compared with its size, it has a large amount of algae growth, suggesting that factors other than size of the lake and its drainage area may explain the predisposition to algal blooms. This leaves as the main possibility the high inputs of nutrients from the shores around the Lake (Aquality, 2008).
3.4.2 Developments Along the shore of Pigeon Lake

Much of the hydrological and water quality story of Pigeon Lake has to do with the numerous developments along its northern and southern shorelines. As of 1985, there were over 2300 private cottages, 10 summer villages (mainly active in the summer), and 9 hamlets established on its shores (Battle River Regional management Commission 1985). Among the communities dotting the lake contour, the most prominent ones are Mulhurst Bay, Golden Days, Ma-Me-O Beach, Grandview, Crystal Springs, Mulhurst and Sundance Beach with smaller populations at Poplar Bay, Argentia Beach, Silver Beach, Norris Beach and Itaska Beach. Populations of the summer villages in particular can increase from less than 100 in the winter months to over 2,000 during the summer months (Aquality, 2008).

3.4.3 Physical Parameters of Pigeon Lake

Table 3.1: The physical parameters of Pigeon Lake (Mitchell and Prepas (1990), as quoted in Aquality (2008)).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation (m)</td>
<td>849.48</td>
</tr>
<tr>
<td>Surface Area (km2)</td>
<td>96.7</td>
</tr>
<tr>
<td>Volume (m$^3$)</td>
<td>603 x 106</td>
</tr>
<tr>
<td>Maximum depth (m)</td>
<td>9.1</td>
</tr>
<tr>
<td>Mean depth (m)</td>
<td>6.2</td>
</tr>
<tr>
<td>Shoreline length (km)</td>
<td>46</td>
</tr>
<tr>
<td>Mean annual lake evaporation (mm)</td>
<td>664</td>
</tr>
<tr>
<td>Mean annual precipitation (mm)</td>
<td>534</td>
</tr>
<tr>
<td>Mean annual inflow (m$^3$)</td>
<td>17.0 x 106</td>
</tr>
<tr>
<td>Mean residence time (yr)</td>
<td>&gt;100</td>
</tr>
<tr>
<td>Sill elevation (m)</td>
<td>849.8</td>
</tr>
</tbody>
</table>


3.4.4 Hydrology of Pigeon Lake

To the north of Pigeon Lake, a broad ridge of land runs roughly east to west, so that drainage in the north part of the ASP area drains toward the north, northwest and northeast, entering the North Saskatchewan River drainage system via the Weed Creek and Sunnybrook Creek systems. In the northwest, the drainage is ultimately toward Strawberry Creek, also a tributary of the North Saskatchewan River. South of this ridge, the water drains generally toward the north shore of Pigeon Lake. Thus, surface drainage in the southwest of the ASP area flows eastward via Tide Creek and its two tributaries entering from the north. Drainage on the southeast of the ASP area flows via several small intermittent creeks south and southwest to the Lake.

Pigeon Lake is believed to be fed largely by natural springs. In a water balance study developed using data from 1965-1980, it was estimated that land run-off contributed $18 \times 10^6$ m$^3$ of water to the lake each year (Evans, 1981). Precipitation was estimated
to contribute another 50 x 10^6 m^3 of water annually. Lake evaporation was estimated to be 60 x 10^6 m^3 per year (Evans, 1981). The main outflow for the lake is Pigeon Lake Creek, which flows south into the Battle River. The inferred outflow from the creek is 8 x 10^6 m^3 per year (Northwest Hydraulic Consultants, 1981). Water in Pigeon Lake has a very long residence time (>100 years). Therefore, any unusual inflow simply raises the water level (Pigeon Lake Study Group, 1975). The lake has a mean annual maximum elevation above sea level (a.s.l.) of 850.04 m and a mean annual minimum elevation a.s.l. of 849.76 m (Evans, 1981).

In 1914, a weir was installed on Pigeon Lake Creek to prevent flooding of hay fields downstream. In 1986, the weir was replaced with a new structure and a fish ladder. The weir maintains the lake water level at an elevation of 849.95 m a.s.l. (Mitchell and Prepas, 1990). Over the years, the water level in Pigeon Lake has fluctuated by about 1.0–1.5 m (max. 850.71 m in 1948, min. 849.33 m in 1968) (Evans, 1981), which is typical for lakes in central Alberta (Evans, 1981; Mitchell and Prepas, 1990) (Aquality, 2008).

### 3.4.5 Water Quality of Pigeon Lake

Table 3.2: Major ions and related water quality variables for Pigeon Lake. (Alberta Environment unpublished data, Naquadat station 01AL05FA1500).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (range)</td>
<td>8.2-8.6</td>
</tr>
<tr>
<td>Total alkalinity</td>
<td>152 mg/L</td>
</tr>
<tr>
<td>Specific conductivity (μS/cm)</td>
<td>283</td>
</tr>
<tr>
<td>Total dissolved solids (calculated)</td>
<td>155 mg/L</td>
</tr>
<tr>
<td>Total hardness (calcium carbonate, CaCO3)</td>
<td>107 mg/L</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>179 mg/L</td>
</tr>
<tr>
<td>Carbonate</td>
<td>&lt;4 mg/L</td>
</tr>
<tr>
<td>Magnesium</td>
<td>10 mg/L</td>
</tr>
<tr>
<td>Calcium</td>
<td>26 mg/L</td>
</tr>
<tr>
<td>Sodium</td>
<td>16 mg/L</td>
</tr>
<tr>
<td>Potassium</td>
<td>5 mg/L</td>
</tr>
<tr>
<td>Chlorine</td>
<td>&lt;1 mg/L</td>
</tr>
<tr>
<td>Sulphate</td>
<td>&lt;5 mg/L</td>
</tr>
</tbody>
</table>

Pigeon Lake is a well-buffered, freshwater lake, with bicarbonate and calcium moderating the acidity of the lake water (Aquality, 2008). Due to the large size and shallow depth of Pigeon Lake, the water mixes from the lake surface to the bottom on windy days during most of the open-water period. As a result, the water temperature is generally uniform (Bidgood, 1972), and dissolved oxygen concentrations remain relatively stable throughout the water column up to a depth of 8 m. Only at a depth greater than 8 m does the water column become devoid of oxygen. In addition, dissolved oxygen may be depleted near the lake bottom by late winter. Winter kill of fish is unlikely, because there is sufficient dissolved oxygen in the upper portions of the water column. Similarly, water temperature is relatively constant throughout the water column, and the lake does not stratify, i.e., no thermocline forms that separates warmer water near the surface from colder water at greater depths (Aquality, 2008).
The input of nutrients (nitrogen and phosphorus containing compounds, which may originate from the use of fertilizers near Lake, leaking septic tanks, livestock manure, or other sources) has been an important determinant in the water quality of Pigeon Lake. Pigeon Lake is mesotrophic to mildly eutrophic, with total phosphorus concentrations ranging from 29-35 μg/L. The term eutrophic refers to a water body that has a more than natural level of nutrients, to the point where blooms of algae occur and water quality is compromised. Mesotrophic means that there is a moderately high level of nutrients in the water, less than the eutrophic state. Whether a lake is eutrophic or mesotrophic can be determined by measuring the amounts of phosphorus in the water, and by measuring the concentration of chlorophyll a which is an indirect measure of the abundance of algae in the water.

Studies of water quality in Pigeon Lake indicate that there is considerable annual variation in mean concentrations of total phosphorus and chlorophyll a, increasing during summers to peak levels in late August. This pattern is typical of shallow lakes in Alberta, and it is why many of them display problems with high levels of algae and turbidity. The long retention time of Pigeon Lake, as explained above, reduces the “flushing” effect of water flow-through, aggravating and extending the periods of algal blooms in the lake (Aquality, 2008).

Agricultural practices are thought to contribute some 30% of the total external phosphorus supply to Pigeon Lake. Phosphorus loss from agriculture can come from point and diffuse sources. Point sources include waste water from farms and dairies and seepage from manure stores. Diffuse sources relate to individual fields, where soil erosion, surface runoff, and drainage represent the major pathways of phosphorus transport into aquatic ecosystems (Daniel et al., 1998). In addition, the transport of soil particles by wind is thought by some to be one of the major pathways of phosphorus into lakes. Tillage practices tend to re-distribute soil particles and nutrients, resulting in dust production and phosphorus transport. Fine soil particles can be carried by wind along with chemically bound nutrients, including nitrates, phosphates, fertilizer, and microorganisms. The deposition of windblown particles into lakes can cause algal blooms as well as siltation and sedimentation (Aquality, 2008).

Micro-organisms such as bacteria represent another environmental/health issue. Fecal coliforms include the bacteria that are found in human feces (as well as animals like cattle, pigs or sheep) and these are capable of causing disease such as gastroenteritis if humans come into contact with contaminated water, either by drinking in it or swimming/bathing in it. Fecal coliform bacteria can enter aquatic systems through direct discharge of waste from mammals and birds, from agricultural and storm runoff, and from untreated human sewage. The recreational water quality guideline for indicator bacteria is 200 fecal coliforms, or 200 E. coli, per 100 ml of sample (CCME 2007). While fecal coliform counts in Pigeon Lake are generally below the Health Canada and CCME guideline recommendations, it must be remembered that the above sources can introduce nutrients into the water as well as pathogenic micro-organisms.
3.4.6 Sediments in Pigeon Lake

The sediments of Pigeon Lake consist primarily of silt and clay, which are fine-grained minerals, with sand comprising only a minor component (Aquality, 2008). Sediments largely accumulate on the bottoms of lakes as inflows from rivers, creeks and direct runoff from land transport suspended particulate material from the surrounding lands. The elemental composition of the sediments in Pigeon Lake is characteristic of the underlying geologic formation, the Paskapoo Formation (see under Geology). Sediment composition plays a significant role in determining nutrient availability in lake water. Phosphorus is readily adsorbed (chemically bound) to clay particles in sediments. Similarly, iron and aluminum can bind with phosphorus and precipitate it.
out of the water column. This removes phosphorus from the biochemical cycles that can result in algal blooms. However, neither clay, iron nor aluminum concentrations in the sediments decrease phosphorus concentrations sufficiently to limit growth of algae and plants in Pigeon Lake (Aquality, 2008).

The sediments of Pigeon Lake also contain various hydrocarbon compounds, which are common in crude oil, or form during commercial chemical processes. While several of these are considered carcinogenic (causing cancer), mutagenic (causing mutations) and/or teratogenic (causing birth defects), their concentrations in Pigeon Lake are below the CCME Sediment Quality Guidelines (Aquality, 2008).

3.4.7 Vegetation in Pigeon Lake

In plant surveys around Pigeon Lake, the most frequently occurring species were northern watermilfoil (Myriophyllum exalbescens), stonewort (Chara sp.), Richardson pondweed (Potamogeton richardsonii) and widgeon grass (Ruppia cirrhosa) (Aquality, 2008). The dominant emergent species in lacustrine marshes was common great bulrush (Scirpus validus). Its distribution is limited by substrate type and most prevalent in areas of low cottage density (Haag and Noton, 1981). A dense patch of great bulrush can be seen at the south end of the beach at the Zeiner Campground at the northwest shore of Pigeon Lake.

Aquatic vegetation performs a number of important ecosystem functions, including water purification and nutrient recycling. It also provides habitat for many invertebrates that are at or near the base of the food chain, such as larvae and nymphs of caddis flies, mayflies and chironomids. They also form spawning areas and sites of egg-deposition for many fish species, including Northern pike, as well as a food source for various animals. The removal of aquatic vegetation, whether submerged or emergent, can result in higher turbidity, increased shoreline erosion, and the removal of a mechanism that absorbs excess nutrients from the water. The maintenance of aquatic vegetation stands is important in maintaining wildlife habitat and water quality (Aquality, 2008).

In recent years, cyanobacteria (formerly called “blue-green algae”) belonging mainly to Anabaena and Lyngbya have been responsible for blooms and deteriorating water quality in Pigeon Lake. Their fast growth and reproductive rates provide them with a competitive advantage over algal species in the same habitat. Blooms usually develop in nutrient-rich lakes during the summer months when the water is warm and slightly to moderately alkaline. However, variations in air and water temperatures, total sunlight and wind velocity also influence bloom development (Aquality, 2008).

Even though the lake is well circulated and shallow, so it is well mixed, the residence time of water in the lake is quite long (i.e., more than 100 years). As mentioned above, there is very little “flushing out” of nutrient-rich lake water. The combination of warm temperatures, calm conditions and high phosphorus levels produce the algal blooms that have been observed over the years. Once the algae complete their life cycle and come to the surface, the wind will concentrate it in areas of shoreline that receive the most wind and wave action. In the Pigeon Lake Water Quality Report 2007 (Aquality, 2008), it is suggested that there may be “hot spots” on the lake, where nutrient concentrations may be particularly high, e.g., at the mouth of an incoming watercourse, high decomposition or sewage release.
Fig. 3.3: The watercourses, major wetlands, peatlands and riparian areas in the North Pigeon Lake ASP area.
3.4.8 Watercourses in the North Pigeon Lake ASP Area

The watercourses and riparian areas in the North Pigeon Lake ASP area are shown in Fig. 3.3. The main watercourse in the North Pigeon Lake ASP area is Tide Creek, which drains much of the southwest part of the ASP area, draining toward the east and discharging into Pigeon Lake at its northwest shoreline. Several other creeks drain the southwest part of the ASP area, flowing southward and draining into Tide Creek from the north.

The headwaters of Sunnybrook and Strawberry Creeks drain the northwest part of the ASP area, while the headwaters of Weed Creek drain most of the northeast part of the ASP area. Both of these drainage systems eventually enter the North Saskatchewan River drainage system.

Riparian area at Leduc Fish & Game Society Lot (WP293).

Beaver dammed watercourse in Strawberry Creek Natural Area (WP281).

Small creek in north of ASP area (WP17). Note cattle trampling of banks.

Tide Creek near mouth, upstream of Hwy. 771 bridge crossing.
Mouth of Tide Creek at Pigeon Lake, downstream of Hwy. 771 bridge crossing.

Small tributary and riparian area north of Tide Creek, crossing Range Road 22 (WP153).

Tide Creek and riparian area at Range Road 25 (WP160).

Sunnybrook Creek, in north of ASP area (WP87).

### 3.4.9 Wetland Areas

Wetland areas in the ASP area include wet meadows, marshy ponds and peatlands (fens and bogs). The major wetland areas in the North Pigeon Lake ASP area are also shown in Fig. 3.3.

Given the elevation and topography, there are relatively few marsh areas or naturally occurring ponds. However, fens and bogs are common on the west side of the ASP area. These peatlands are associated mainly with low-lying lands surrounding Tide Creek and its tributaries. Beaver damming has created strings of ponds and some marshy areas along the small tributaries. An example is at the Strawberry Creek Natural Area, where there is a string of ponds and wetland vegetation.

There is a bog/fen area bordering the northeast corner of the Lake north of Itaska Beach which is associated with a small drainage system to the northeast (between WP182 and WP176).

A beaver pond and associated wetland vegetation is located at WP302, south of the G&M Hutchinson Conservation Easement (SE 25-047-02-W5M). Running through the property from north of Twp. Road 474A is a small watercourse, which becomes a
wetland pond both north and south of Lakeshore Road, which have been largely created by beaver damming. The wetland area is vegetated with marsh reed grass and sedges, typical of such wetland ponds in this region. There is a natural spring that feeds into the creek in the north part of the property, just south of Twp. Road 474A.

Immediately north of Twp. Road 474A, at the Leduc Fish & Game Association Lot (NE 30-047-01-W5M) (WP292), where beaver have blocked a culvert under Twp. Road 474A, there is a large pond, with bulrushes and other wetland vegetation.

There is a mainly treed fen peatland area that drains across Highway 771 just north of the Zeiner Campground. It extends across the properties west of Highway 771. There are also peatlands on the north side of Tide Creek west of its mouth at Pigeon Lake.
3.4.10 Surface Water Issues

Issues that arise concerning surface water and surface water quality in Pigeon Lake and in the North Pigeon Lake ASP area, are set out below. They result from the field observations in August/September, review of the relevant reports and plans, and discussions with local residents.

- Loss of riparian and wetland habitat, through development and through changes in drainage patterns and the local water table. Not only do wetlands (including fens and bogs, marshes, ponds and wet meadows) supply important habitat for waterfowl and other forms of wildlife, they play an important hydrological function. Areas of low, wet land often serve as groundwater recharge areas.
Nutrient inputs to Pigeon Lake and ensuing results on water quality and algal blooms, primarily nitrogen and phosphorus, due to agricultural and residential developments and activities, including:

- livestock manure entering the lake through runoff from grazing lands;
- leakage from old septic tanks;
- use of fertilizers on properties bordering the Lake.

Possibility of nutrients entering the shallow groundwater around the lake, due to livestock manure, septic tanks or use of fertilizers.

Possibility of fecal coliform levels rising in the Lake, through leakage from septic tanks, etc.

Tree cover and lot spacing affect the amount of nutrients flowing to receiving waters. Forested land contributes less nutrients per unit area than cleared land, since the rate of runoff is controlled by vegetation cover and since one source of nutrient transport is through windborne dust. Subdivision development at an acceptable density is one way of maintaining tree cover. The production of phosphorus is about the same from low intensity cow-calf farming and from human settlement at about three houses per acre. It has been calculated that residential lots in the three to five acre range have less effect on lake water quality than if the same land was cleared and farmed (Pigeon Lake Watershed Management Plan).

3.5 GROUNDWATER

A Regional Groundwater Assessment was done in 1999, for Leduc County, by Hydrogeological Consultants Ltd., Edmonton. The following summarizes the findings of that survey.

The west side of the North Pigeon Lake ASP area is underlain by the Upper Lacombe member, while the eastern-most part is underlain by the Lower Lacombe member.

The Upper Lacombe aquifer comprises the porous impermeable parts of the Upper Lacombe member. The thickness of the Upper Lacombe member is mainly between 20 and 60 m but varies from less than 20 m at the northeastern extent to 80 m in the southwestern part of the County.

The Lower Lacombe aquifer subcrops in the southwestern part of the county, and underlies the Upper Lacombe aquifer. The thickness of the Lower Lacombe member is mainly between 40 and 80 m. The depth to the top of the Lower Lacombe member is up to 80 m in the southwestern part of the county (i.e., the North pigeon Lake study area).

The apparent yields for individual water wells completed through the Upper Lacombe aquifer were mainly between 10 and 100 m³ per day. Apparent yields of more than 100 m³ a day are expected mainly in Ranges 03 and 04 W5M, which includes most of the North Pigeon Lake ASP study area.
In terms of groundwater quality, total dissolved solids (TDS) in groundwater from surficial deposits in the west side of the study area are less than 500 mg per liter, while in the east part there are no saturated surficial deposits. Sodium bicarbonate type groundwaters predominate in Leduc County. In Leduc County, chloride concentrations are generally less than 30 mg per liter. However in some areas, sulfate levels are high.

While TDS concentrations in the groundwaters from the upper bedrock aquifers in the County as a whole range from less than 200 to more than 2000 mg per liter, those for the ASP study area contain between 200 and 500 mg per liter of TDS.

Groundwater from the Upper Lacombe aquifer is mainly of the sodium bicarbonate type, with TDS concentrations mainly less than 500 mg/L, with higher values mainly in townships 47-49, ranges 02-04, W5M. Sulfate concentrations are generally less than 100 mg per liter. The chloride concentrations range from less than 4 mg per liter to a high of 13 mg per liter.

The groundwaters from the Lower Lacombe aquifer are mainly of the sodium bicarbonate type. The TDS concentrations are most between 500 and 750 mg per liter. The higher values are in the southwestern corner of the county. The sulfate concentrations are generally less than 100 mg per liter. Chloride concentrations in the groundwaters from the Lower Lacombe aquifer range from less than 4 to more than 10 mg per liter.

**Fig. 3.4:** Total dissolved solids in groundwater from surficial deposits (from Hydrogeological Consultants Ltd., 1999).
The fluctuations in groundwater levels (in the Upper Lacombe aquifer, at 9.1 m depth) were compared with the summer precipitation (at the weather station in Calmar). The comparison showed that the groundwater levels reflect changes in summer precipitation. Highest peaks in water level occurred in 1986, 1990 and 1991. These peaks correspond to three of the four highest years of summer precipitation to that time. The water level fluctuations showed two peaks for most years. The first peak would be associated with recharge when the frost leaves the ground and the second would coincide with the end of the growing season. The low water level at the start of each year is a result of no recharge to the groundwater flow system during the time of ground frost.

Fig. 3.5: 

*Figure 27. Summer Precipitation vs Water Levels in AEP Obs WW No. 320*  
(from Hydrogeological Consultants Ltd., 1999).

The hydraulic gradient between the surficial deposits in the upper bedrock aquifers was determined by subtracting the non-pumping water level surface associated with all water wells completed in the upper bedrock aquifer, from the corresponding figure for all water wells in the surficial deposits. In more than 50% of Leduc County there is a downward hydraulic gradient from the surficial deposits toward the upper bedrock aquifers. The west part of the North Pigeon Lake ASP area is mainly in the recharge zone, while most of the east part of the North Pigeon Lake ASP area is a transitional zone (i.e., 5 m difference in level or less).

This information is important in terms of the potential for groundwater contamination. The possible sources of contamination that can impact groundwater include effluent from leaking lagoons or septic fields, leakage of leachate from landfills, petroleum products from storage tanks or pipeline breaks, the spreading of fertilizers, pesticides and manure.
In areas where there is groundwater discharge, it is less likely that liquid contaminants can enter the groundwater flow systems to be distributed throughout the area. In groundwater recharge areas, however, higher permeability materials allow the downward movement of liquid contaminants. Once a liquid contaminant enters the subsurface, the possibility for groundwater contamination increases if it coincides with a higher permeability material within 1 m of the land surface. The southern parts of the North Pigeon Lake study area, i.e., the lands adjacent to the shore of the lake, lie in a “high” risk category, while the more northern parts of the study area lie in a “low” risk category.

Fig. 3.6: Recharge/discharge areas between surficial deposits and upper bedrock aquifer(s) (from Hydrogeological Consultants Ltd., 1999).
3.6 VEGETATION COMMUNITIES

3.6.1 Ecozone Description

The vegetation of the Dry Mixedwood sub-region is transitional between the Central Parkland and Central Mixedwood sub-regions, and there are community types common to all three. Trembling aspen (*Populus tremuloides*) is an important species in all three sub-regions, occurring in both pure and mixed stands. Balsam poplar (*Populus balsamifera*) frequently occurs with aspen especially on moister sites in depressions and along streams. Coniferous species are more common further north in the Dry Mixedwood sub-region with mixed stands of aspen and white spruce being widespread. Dry, sandy upland sites are usually occupied by Jack Pine (*Pinus banksiana*) forests. Peatlands are common throughout the sub-region and are extensive in some areas.

3.6.2 General Forms of Vegetation Communities

Other than developed areas (i.e., farmyards, houses and lots, transportation infrastructure, etc.) five general types of vegetation community were recognized throughout the field reconnaissance of the Pigeon Lake ASP area. They are:

- Agricultural pasture or cultivated fields
- Mainly deciduous forest
- Mainly coniferous forest
- Peatland (bog/fen)
- Marsh / pond wetland or riparian area

Each of these general vegetation communities is described below.
Fig. 3.7: The distribution of vegetation communities in the North Pigeon Lake ASP area. Light green areas indicate mainly deciduous treed vegetation (aspen, poplar). Dark green areas indicate mainly coniferous vegetation (white spruce, black spruce, larch, pine). Note: Outlines are not intended as precise, since coniferous and deciduous areas have transition zones, and in some areas coniferous trees occur in small clumps or around farmyards, etc.
Fig. 3.8:  Focus sites observed in the field studies, August/September 2009 (east side of study area).
Fig. 3.9: Focus sites observed in the field studies, August/September 2009 (west side of study area).
Agricultural Pasture or Cultivated Fields

Aside from crops under cultivation or bare/stubble fields, the vegetation of pastures is of common grasses such as wheatgrass and timothy, but often also having invasive weed plants such as thistles, goldenrod, common plantain, asters, dandelions, dock and wild rose. The areas have been disturbed to greater or lesser extent by agricultural clearing, cultivation and cattle grazing. In some cases, it was evident that cattle were allowed to go along and through the banks of small creeks, trampling vegetation and causing siltation. Many of the pastures are bordered with shelterbelts (mainly of balsam poplar and trembling aspen), and in places small copses of these trees have been left. In many places, lower wetter areas of the fields have been spared from ploughing, leaving treed or shrubby vegetation to persist (usually poplar, aspen and willow). Trees have been planted around farmyards, usually spruce.
Mainly Deciduous Forest

The most extensive treed area of the North Pigeon Lake ASP zone is composed of mainly deciduous forest. These are stands of various size that area dominated by trembling aspen, balsam poplar, red osier-dogwood, beaked hazelnut, saskatoon and several willow species. The trees may be young to mid-age to mature, and range up to about 30 cm DBH (diameter breast height). The substrate may be of common grasses and/or leaf litter as well as various forbs. While these stands may be vegetated mainly with deciduous trees and shrubs, there are often a small number of white spruce and white birch within the area. The distribution of white spruce in such forests is heavily dependent on (1) logging and fire history, and (2) proximity to a seed source.

Several major types of deciduous forest exist in the Dry Mixedwood sub-region, i.e., one dominated by trembling aspen (drier sites), and one dominated by balsam poplar on moister sites in depressions and in the northern part of the subregion. Both are characterized by a diverse understory. Species characteristic of the aspen forest type include snowberry (*Symphoricarpos albus*), saskatoon (*Amelanchier alnifolia*), beaked hazelnut (*Corylus cornuta*), choke cherry (*Prunus virginiana*), bunchberry (*Cornus canadensis*), wild lily-of-the-valley (*Maianthemum canadense*) and false melic grass (*Schizachne purpurascens*).

In the moister (poplar dominated) areas, the understory is very diverse, consisting of such plants as red osier dogwood (*Cornus stolonifera*), pussy willow (*Salix discolor*), northern gooseberry (*Ribes oxyacanthoides*), green alder (*Alnus crispa*), bracted honeysuckle (*Lonicera involucrata*), bluebells (*Mertensia paniculata*), palmate-leaved coltsfoot (*Petasites palmatus*), Bishop’s cap (*Mitella nuda*) and baneberry (*Actaea rubra*). Species common to both types include wild rose (*Rosa acicularis*), woods rose (*Rosa woodsii*), low-bush cranberry (*Viburnum edule*), wild red raspberry (*Rubus idaeus*), dewberry (*Rubus pubescens*), twining honeysuckle (*Lonicera dioica*), highbush cranberry (*Viburnum opulus*), wild sarsaparilla (*Aralia nudicaulis*), bearded wheat grass (*Agropyron trachycaulum*), bracted honeysuckle (*Lonicera involucrata*), fairy bells (*Disporum trachycarpum*), pink wintergreen (*Pyrola asarifolia*), Lindley’s aster (*Aster ciliolatus*), northern bedstraw (*Galium boreale*), fireweed (*Epilobium angustifolium*), creamy peavine (*Lathyrus ochroleucus*), American vetch (*Vicia americana*), horsetails (*Equisetum spp.*) and star-flowered Solomon’s seal (*Smilacina stellata*).

The understory of the deciduous forest, as viewed in the North Pigeon Lake ASP area, was usually comprised of red osier dogwood, beaked hazelnut, snowberry, saskatoon, high bush cranberry, baneberry, Canada anemone, wild sarsaparilla, fringed aster, bunchberry, wild strawberry, northern bedstraw, creamy peavine, bracted honeysuckle, tall lungwort, palmate coltsfoot, northern black currant, northern gooseberry, prickly wild rose, wild raspberry, star-flowered false Solomon’s seal, veiny meadow rue, stinging nettle, wild vetch and Western violet. In most of the areas viewed, the forest appeared vigorous and healthy, and there were relatively few signs of senescence or disease. However, in some areas there were signs of stem breakage, due to a combination of weakness and exposure to prevailing winds.
Mainly Coniferous Forest

Coniferous species are common in the Dry Mixedwood sub-region with mixed stands of aspen and white spruce being widespread. Dry, sandy upland sites were in many places occupied by jack pine (Pinus banksiana). Many of the same understory plants are present in coniferous forests. Technically, these forests are referred to as mixedwood forests. In the present sense, the forest was considered as mainly coniferous forest if the proportion of white spruce was approximately 50% or more.

In some areas, stands of mature black spruce and larch dominate the plant community. These usually constitute peatlands, which are described below. The white spruce dominated forest, which usually is found on upland slopes in association with poplar or aspen, is a different community from black spruce / larch dominated forest, which are associated with low-lying peatland areas. However, they are somewhat difficult to distinguish in aerial maps, and the two forest types often form a transition between one and the other. Accordingly, the boundaries between coniferous dominated upland forest and black spruce / larch dominated peatland, as shown on the vegetation map, are approximations.
Peatland (Bog/Fen)

Peatlands are common throughout the Dry Mixedwood sub-region and are extensive in some areas. Peatland areas typically contain nutrient-poor, acidic bog portions, dominated by black spruce, Labrador tea and peatmosses (*Sphagnum spp.*). More nutrient-rich fen areas may contain larch trees, dwarf birches (*Betula pumila*), sedges (*Carex spp.*), bog cranberry (*Vaccinium vitis-idaea*), reindeer lichen (*Cladonia alpestris*), feathermosses and brown mosses. Fens are lower, poorly drained areas that are fed by groundwater and have relatively high nutrient levels, as compared with bogs, which are surface water fed and have low levels of nutrients. Some species of rare orchids and other plants are typically found in fen or bog habitats.

In the North Pigeon Lake ASP area, the peatlands are mostly in the west part of the planning area and are associated with the lands surrounding Tide Creek and its two tributaries entering from the north. A significant portion of this area consists of fen dominated by black spruce, larch, dwarf birch, willow, other shrubs, and sedges.
Marsh / Pond Wetland or Riparian Area

Marsh and pond forms of wetland occur as a result of the rolling contours of the area, and often occur in points of lower elevation. In such areas, the moisture may have discouraged ploughing, and the wetland vegetation has been allowed to flourish. They may also be associated with creeks and their riparian areas, often as a result of beaver activities. Depending on the amount of standing water, the vegetation may be dominated by cattails and bulrushes where there is standing water for a majority of the growing season; or it may be comprised mainly of sedges, marsh reed grass, slough grass, manna grass and other emergent plants where the wetland is flooded for only the early part of most summers. They may be ringed with willows of several species around the periphery. Other plant life may include water hemlock, water parsnip, wood rushes, pondweed, duckweed, water cinquefoil and arrow-leaved coltsfoot.
3.6.3 General Distribution of Vegetation

The distribution of the five vegetation communities outlined above, are shown in Fig. 3.7, which is based on an aerial photograph (orthograph) of the study area. Light green represents mainly deciduous forest (as defined above), while deep green represents mainly coniferous forest. Wetland areas (including treed fens, untreed fens and marshy wetlands) are shown in light blue. The borders distinguishing deciduous from mainly coniferous are intended as approximate, since these areas transition from one to the other, and since white spruce often form relatively small patches, perhaps due to past logging activities but also due to soil moisture, slope and aspect.

It can be seen from the figure that within the North Pigeon Lake ASP area, the distribution is heavily influenced by the topography and the pattern of surface water flows. In the upland areas, particularly in the north part of the ASP area, but also south of the height of elevation, most of the land has been cleared of trees, largely due to the development of agriculture, and it exists in the form of agricultural pasture or cultivated fields. Shelterbelts and small copses of balsam poplar and trembling aspen (and occasionally white spruce) have been left to grow, mainly around the edges of fields and in low areas where it is too wet to plough. Forest harvesting over the past century, as well as fires, has had a strong influence on the vegetation that remains. Some areas that were originally mixedwood poplar/aspen/white spruce vegetation (which is the climax vegetation community) have been logged or burned over and now support a forest of deciduous trees (aspen/poplar/birch and various other trees and shrubs of the understory). An example is the land south of Twp. Road 474A and NE 30-047-01-5 on the northwest shore of Pigeon Lake. It was burned in the 1960s and now comprises a forest of mature poplar/aspen. Various other examples exist of where only part of a section of land was logged of spruce, and now the logged part contains only deciduous trees while the unlogged part is a mixedwood forest of aspen/poplar/white spruce. Thus, the logging and fire history, as well as topography and drainage, has had a strong effect on the types of trees and vegetation communities in the ASP area.

It can be seen from Fig. 3.7 that most of the land in the northern part of the ASP area is pasture or cultivated fields, with small blocks and shelterbelts of mainly deciduous forest. The upland areas of the south part of the ASP area (i.e., those sloping down from the north, as the land descends toward the Lake) are similar, particularly on the east side of the planning area. However, in the west part of the ASP area, the vegetation is strongly influenced by the pattern of watercourses and the depressions in the land, primarily Tide Creek and several tributaries that drain southward and eastward from the height of land that arcs around the north of the Lake. The slopes that lie along these watercourses generally have a higher concentration of coniferous vegetation, primarily white spruce, although jack pine occurs in slightly higher situations with sandy soils (shaded in dark green in Fig. 3.7). This would be a result of wetter conditions or logging history, or both factors. Nearer to the watercourse itself, and in low-lying and poorly drained areas otherwise, peatlands (bogs or fens) and wetlands exist (shaded in blue in Fig. 3.7).

The major area of coniferous dominated treed areas is associated with Tide Creek, although much of the coniferous area is actually south of the County line with Wetaskiwin County. Coniferous forest and peatlands are the major type of forest vegetation along the Creek on both the north and south sides. With further distance
west and north, and higher in elevation (i.e., the headwaters of the Creek and its tributaries) the forest becomes mixedwood and then deciduous.

In the eastern of the two tributaries to Tide Creek, the area of coniferous and mixedwood forest extends further to the north and west. In the western of the two tributaries, the area of coniferous and mixedwood forest extends to the Strawberry Creek Natural Area. Further northwest, the drainage changes to the northward, entering the Strawberry Creek drainage system.

There are numerous areas of peatlands (bogs and fens), particularly in the riparian areas and headwaters of Tide Creek and its tributaries. An example is where the tributary crosses Twp. Road 474 at WP99. Here, there is a boggy area with the characteristic vegetation assemblage of black spruce, larch, birch, Labrador tea and moss.

Another area of peatland is south of Twp. Road 474 and west of Hwy. 771, including SW 23-047-02-5 and the lands to the north, west and east. The drainage of this area comes from several springs, to the north and west. In fact, the students of the school at WP152 used to get their water from one of these springs (Mr. Bill Wood, pers. comm., 2009). This drainage seeps through a mossy area of fen vegetation and eventually flows eastward under Hwy. 771, into a wetland just north of Zeiner Park, and from there into Pigeon Lake.

A forest, wetland and bog complex is located at the northwest corner of Pigeon Lake, just north (and south) of Twp. Road 474A. It is a Conservation Easement under the Nature Conservancy of Canada, donated by Mr. and Mrs. G.M Hutchinson.

A coniferous treed and boggy area is to be found at the northeast corner of Pigeon Lake, near Itaska Beach. Part of this and adjoining area has been purchased by a group of local residents along the shore (Itaska Audubon Society), for the purpose of conservation in perpetuity.

3.6.4 Site Vegetation Features

Due to the size of the study area, it was not considered practical to describe each vegetation patch. However, from the above discussion, that it can be described in terms of the distribution of the five vegetation assemblages. In the following, sites that are located in potentially sensitive areas such as the riparian zones of the watercourses, the low-lying peatland areas, coniferous forest areas and the Pigeon Lake shoreline are described. In addition, examples of deciduous forest and other upland areas are described. It was felt that this approach would provide a good overall description of the vegetation in the ASP area, but concentrating on those sites that are likely to be ecologically diverse and/or sensitive to disturbance or changes in water balance and so forth.

Sites 1 through 19 illustrate watercourses and wetlands, while sites 24 – 30 provide perspectives along the shore of Pigeon Lake. The locations of the sites are shown in Figs. 3.8 and 3.9.
Site 1 (WP97)

At this site, Range Road 31 crosses a small creek which is part of the headwaters of Strawberry Creek. Strawberry Creek runs to the west outside of the project area, and ultimately joins with the North Saskatchewan River. To the west of the road there is a large wetland area, and beyond that to the west, coniferous and mixedwood forest areas. To the east, within the study area, the land is rolling and hummocky pasture. There is a stand of deciduous forest to the southeast.

Stand of deciduous forest to the southeast of WP97. Rolling pasture east of Range Road 31 at WP97. Wetland west of Range Road 31, mixed wood forest in distance.
Site 2 (WP329): Branch of Tide Creek

At WP329, a branch of Tide Creek crosses Twp. Road 474, flowing toward the south and east. Here, the land bordering the creek on both east and west is peatland dominated by black spruce, larch, Labrador tea, horsetails and moss. Other ground plants included bunchberry, wild strawberry and grasses. Numerous wildlife trails and sign were observed in this area, with at least one well-used trail exiting to Twp. Road 474. It is evident from this that wildlife (moose, deer and other) move along this peatland area.

Black spruce / Labrador tea community at WP327.

Larch / black spruce / paper birch community at WP328.

Larch / black spruce community at WP329.

At north side of Twp. Road 474 at WP329.
Site 3 (WP101): Tide Creek

In the headwaters of Tide Creek. At WP101, there is a pool, evidently formed by a beaver dam on the south side of the road. There is mixedwood forest to the north, but black spruce forest, typical of boggy areas, to the south.

Forest areas on both sides of WP101. Pool formed by Beaverdam on the south side of road, part of Tide Creek drainage.

Site 4 (WP326): Branch of Tide Creek

This is another branch of Tide Creek, east of the branch referred to at Site 3. The Creek branch crosses Twp. Road 474 here. East of this, the vegetation is all deciduous forest. West of this point, is forest of pine, white spruce, aspen, white birch.

Branch of Tide Creek crossing Township Road 474, south side. Branch of Tide Creek crossing Township Road 474, north side.
Forest and meadow along Township Road 474 near WP326.

Site 5 (WP161): Branch of Tide Creek

This is a branch of Tide Creek, entering the main stem from the north. At this site, there is a transition from white spruce-dominated mixedwood forest along the creek, to open fields to the west.

Tide Creek branch, east side of Range Road. Note mixedwood forest.

Tide Creek branch, west side of Range Road, showing meadow area.

Stand of spruce and pine at WP161.
Site 6 (WP158): Tide Creek Ravine, North Side

At the south end of Range Road 24, at the top of the valley, the forest is predominantly balsam poplar on both the east and west. Some white spruce in stand to the west, with deciduous to the east. There are open fields immediately to the east, with balsam poplar / trembling aspen stands further east.

Site 7 (WP277-288): Strawberry Creek Natural Area

The south half of the Section 29-047-02-W5M which lies north of Twp. Road 474 and west of Range Road 24, is reserved by the County under Protective Notation as a Recreational Natural Area (130 acres). An intermittent creek runs in an approximately north to south direction through the east of the two quarter sections, ultimately draining into the main stem of Tide Creek further to the south. The creek and its riparian area form series of pools which are largely the result of beaver damming activities. Abundant beaver sign was evident along the creek.

The area supports a diverse range of plant communities ranging from early successional stands of willow and alder along the creek, to mature mixedwood (aspen-white spruce) and white spruce stands on upland areas.

Because of its relative seclusion from roads, noise and human activities, the area provides excellent habitat for ungulates, small mammals, birds, amphibians and invertebrates in a relatively undisturbed setting. It is a good example of undisturbed aspen parkland, with elements of climax forest, i.e., mature poplar/aspen/white spruce.

As Westworth (1990) observed, there is some potential for contamination of the creek from agricultural runoff, particularly to the northeast where agricultural lands slope toward the creek, and which supports cattle grazing.

During the September 4, 2009 field reconnaissance, it was evident that from the area of entry from the east side on Range Road 24, into the forest area contained many wildlife trails. Frequent signs of moose and deer were observed. While dominated by mature balsam poplar and trembling aspen, the upper canopy also contained mature white spruce, some of which ranged to 56 cm DBH. Nearer to the creek, there were patches of forest dominated by white spruce, paper birch and Labrador tea. At the
bank of the creek, a patch of blueberries was observed. The whole area contained a rich understory, suitable for ungulate browsing. Ground vegetation consisted of bunchberry, Canada anemone, northern gooseberry, wintergreen, honeysuckle, fairy bells and Lindley’s aster, with leaf litter, grasses and deadfalls being the main ground cover.

The small (1 ha) clearing located in the northeast corner of the site could serve as an access point from RR24, for interpretive trails.

The north part of the western quarter-section of the area (i.e., SW 29-047-02-W5M) was dominated by white spruce, and accordingly it is more coniferous in character than the eastern half described above. This lends additional structural and habitat diversity to the area.
The forest floor and its vegetation (WP277).

Coniferous part of the forest (WP277).

Old stump, with evidence of woodpecker activities (WP280).

Labrador tea in coniferous portion of forest (WP280).

Stand of paper birch (WP280).

Patch of blueberries (WP281).
Looking north along the creek from one of the beaver dams (WP281).

Looking south along the creek from the same point (WP281).

Evidence of ungulates using the creek (WP281).

Further south along the creek, with dead wood as evidence of changes in water level due to beaver activities (WP284).

The forest vegetation in the south part of the area (WP285).

The creek, as it crosses under Twp. Road 474 at the south edge of the area (WP141).
The northwest part of the half section forming the natural area, as viewed from Range Road 25; note mainly coniferous stand (WP288).

The spruce/larch/birch community on west side of Range Road 25, which appears to be the extension of moist area in northwest part of Natural Area (WP289).

Site 8 (WP157): Top of Tide Creek Ravine

Much of the Tide Creek ravine, viewed here from the north, is a mixedwood forest dominated by white spruce. The more upland forests adjacent to this point, are deciduous.

Looking south toward Tide Creek ravine, from WP157.

Land to the NW of WP157.

Tide Creek valley, viewed from WP157.

Forest and fields to the west of WP157.
Site 9 (WP168): Minor Branch of the Eastern Tributary of Tide Creek

This minor branch of Tide Creek supports a community of black spruce and larch in its riparian area. However, the surrounding patches of forest are mainly deciduous.

Black spruce / larch community associated with minor drainage, WP168.
Vegetation on both sides of Range Road 24.

Site 10 (WP147): Eastern Tributary of Tide Creek

The forest surrounding the eastern tributary of Tide Creek, where it crosses Twp. Road 474, comprises a community of balsam poplar, trembling aspen and white spruce. There is a culvert accommodating the creek’s flow, and there is a beaver screen on the culvert.

Predominantly pasture and deciduous treed vegetation along Twp. Road 474.
Creek riparian area on south side of Twp. Road 474.
Creek riparian area on north side of Twp. Road 474.

Site 11 (WP155): Tide Creek

This site is where Tide Creek crosses Range Road 22. On the east side of the road, is the George and Joan Mitchell Conservation property (AFGA). On the west side, a conservation area under Alberta Fish and Game Association.

On the shores of the creek are dense forest composed of white spruce and larch, with birch and other trees and shrubs. From Tide Creek to the north along the road, there is a gradation in vegetation from coniferous to mixedwood forest, with higher elevation.

Looking south along Range Road 22 towards Tide Creek bridge.

Looking to the SE, Tide Creek in distance.
Looking NE from WP155.

Looking NW from WP155, spruce dominated forest.

Looking west (upstream) from bridge over Tide Creek.

Beaver dam just upstream from bridge over Tide Creek.

Looking east (downstream) from bridge over Tide Creek.
Site 12 (WP SC1): Mouth of Tide Creek

This is where Tide Creek discharges to Pigeon Lake. To the west of the bridge where Hwy. 771 crosses Tide Creek, the creek’s riparian area is spruce-dominated forest, with some poplar, willow and larch. To the east of the bridge, the floodplain of the Lake is not treed, but has shrubby willows and grasses.

Looking downstream (east) toward the mouth of Tide Creek into Pigeon Lake.

Looking upstream (west) from the bridge over Tide Creek at SC-1.

The land NE of the bridge over Tide Creek.

The mouth of Tide Creek.

Looking NW from Tide Creek, toward the Wood property.
Site 13: SW 23-047-02-5 (Wood Property) Peatlands

The peatland north of the Wood property extends to the north, east and west, and it comprises the northwest part of quarter section SW 23-047-02-5. It surrounds a drainage course that begins north of the Wood property and flows eastward through a series of fens and pools, across the highway, draining into a low area on the east side of the highway, and ultimately into Pigeon Lake. The fen complex is vegetated with black spruce, larch, paper birch and Labrador tea, and the floor is composed mainly of mosses and wetland plants such as bunchberry, buffalo berry, bearberry, sphagnum moss, marsh marigold and sedges. At the fence line, the vegetation transitions into a willow-birch community typical of wet peatland areas.

The same peatland system can be seen at the northwest corner of the property, from which it extends north, east and west. Near WP320, at the edge of the peatland area, there is a small forested perimeter with mature poplar, white spruce and a number of pine. Going further into the peatland area, the vegetation comprises a treed fen, dominated by black spruce, larch, dwarf birch, paper birch, sphagnum moss and plants such as marsh marigold. The area is a network of wildlife trails (and possibly cattle). With further distance north, i.e., at WP323 the peatland becomes wetter and dominated by birch, though no standing water was observed in the field reconnaissance of September 18, 2009. At WP324, the vegetation becomes dominated by larch. At WP325, it is primarily of larch and black spruce.
Site 14:  Hutchinson / Conservation Easement Lot SE 25-047-02-W5M

The lot that was owned by Mr. Gerald Hutchinson is a block of mainly deciduous forest bordered on the north by Twp. Road 474A, on the west by Range Road 20A and on the south by Lakeshore Road, just north of the northwest corner of Pigeon Lake. It has been set aside from development as a Conservation Easement, in association with the Nature Conservancy of Canada. Under the terms of the covenant are various restrictions, such as no buildings, clear cutting of trees, cultivation, introduction of non-native species of plants or animals, or off-road vehicle use.

The site was toured on foot in the afternoon of September 11, 2009. The lot is vegetated mainly with balsam poplar / trembling aspen mature or mid-aged forest with several large hayfields oriented southeast-northwest across the lot. Running through the property from north of Twp. Road 474A is a small watercourse, which becomes a wetland pond both north and south of Lakeshore Road, which have been largely created by beaver damming. The wetland area is vegetated with marsh reed grass and sedges, typical of such wetland ponds in this region. There is a natural spring that feeds into the creek in the north part of the property, just south of Twp. Road 474A.

The hayfields are vegetated by timothy, brome grass, yarrow, young willows and other plants typical of open areas. The forested area on the west side of the lot is mature trembling aspen, with saskatoon, alder, paper birch, red osier dogwood, twining and bracted honeysuckle, prickly wild rose, buffaloberry and low bush cranberry. The forest on the east side consists of balsam poplar or trembling aspen dominated stands, with understory of beaked hazelnut, saskatoon, prickly wild rose, and mainly grassy substrates.

In the southeast corner of the lot, in the lower elevation land lying to the east of the beaver pond, there is a small area of black spruce dominated bog vegetation, with Labrador tea and sphagnum moss. Just south of the bog area, as the land rises, is a small stand of white birch.

Annually, from 2001 to 2005, a team of biologists has surveyed the Conservation Easement area, to identify changes in the vegetation (following the cessation of farming activities), wildlife, and a determination of whether the Easement is in compliance with the terms of the agreement. According to observations during the field visit, and the comments made in the 2006 monitoring report (authored by Christy Hoy and Jolene Hilson, and approved by Juanna Thompson, Conservation Representative), white-tailed deer and moose frequent the site. Many species of birds were observed. Trails on the southeast side of the property were well used, as well as trails around the field areas, which are evidently used by equestrians as well as people walking. Rundle’s Mission uses the area for cross-country skiing.

Numerous signs of deer and moose were observed during the site visit, and one dismantled tree stump was apparent evidence of black bear activity. One equestrian was met. She reported that many people from the properties around the lake visit the lot, mainly in the early morning or evenings.

The Hutchinson Conservation Easement of 143 acres contains a mature, healthy deciduous forest, with a small watercourse and riparian area, as well as several large
meadow areas. It also contains a black spruce bog area, as well as a stand of white birch. Because of the diversity of vegetation and the large amount of edge area as well as core habitat, the property appears to support a diverse assemblage of plants and wildlife. It is ecologically connected to deciduously forested areas to the north, east, south and west. Accordingly, its conservation value is high.
Poplar/aspen forest near centre of site (WP306).

Large field on the north side of property (WP307).

Black Spruce forest/bog area (WP311).

Black Spruce bog ground cover, with Labrador Tea and sphagnum moss.

Black Spruce forest upper canopy.

Stand of birch trees (WP309).
Site 15: Leduc Fish & Game Association Lot NE 30-047-01-W5M

Mr. Terry James of the Leduc Fish & Game Association kindly accompanied the investigator on a site visit and tour of this lot on September 11, 2009; and provided information on the background, purpose and features of the site. The lot of 122 acres was purchased by the Association about 20 years ago, for the purpose of preserving wildlife habitat in the area. The horse pasture in the southeast corner is actually rented from Mr. Cliff who owns the property to the east. The Association also holds annual events there (fishing day on Pigeon Lake and barbecue on the lot). From March to June each year, there are no horses on the pasture, in order to encourage wildlife.

The lot is vegetated with a deciduous forest dominated by mature balsam poplar, trembling aspen and paper birch, with willows, choke cherry, high bush cranberry and other small shrubs and trees in the understory. Ground vegetation was typical of deciduous forests on well drained soils in this region, including prickly wild rose, bunchberry, honeysuckle, wild strawberry and wild sarsaparilla.

There is a small watercourse flowing from the northwest corner of the lot toward the south edge and Twp. Road 474B. There is a metal culvert carrying the flow to the south of the roadway, where it continues as a small irregular channel through the forest north of Pigeon Lake. In most of the subject lot, the watercourse is a string of pools, which have been created by intensive beaver damming. At the time of the site visit, there was standing water in the watercourse in the south half of the lot, but in the north part, upstream of a major beaver dam, it was dry. The riparian area was vegetated with typical wetland plants such as marsh reed grass, water parsnip, manna grass, western dock and hair grass, as well as willows around the edges.

Signs of wildlife during the field visit included deer and moose tracks, deer beds, and several woodpeckers and passerine birds. In one location, a stump had been pulled apart, indicative of black bear activity. Bear scats were observed near the road. Mr. James advised that deer, moose, foxes and Canada geese were commonly observed on the lot.

Besides the pasture in the southeast, the lot contains two hayfields running north-south. This provides additional edge habitat, which promotes wildlife diversity. The lot, as a whole, appears to support a diverse assemblage of plants and wildlife. It is ecologically connected to deciduously forested areas to the west and the south. Its conservation value is high.
The pond created by beaver damming, in the south end of the Leduc Fish & Game Association Lot (NE 30-047-01-W5M) (WP292).

Deciduous forest vegetation in the north-west part of the lot.

Dried out pool above the major beaver dam, in the north part of the lot (WP294).

The south end of the pool, where is drains under Twp. Road 474B (WP292).

One of the hayfield areas within the lot.

The watercourse in the north part of the lot (looking northward) (from WP294).
Possible evidence of black bear activity (WP296).

Forest near the centre of the lot.

Older poplar/aspen trees near centre of lot.

Deer (or moose) bed in the field area.

Stand of birch trees.

Beaver guard on culvert, north side of Twp. Road 474B (about 100 m east of WP292).
Site 16: RR13 and Twp Rd 474A (WP176, 182)

There is a small creek indicated at this location on 1:50,000 mapping, but it is very minor. No running water could be found. The surrounding vegetation is deciduous.

Site 17: RR13 North of Hwy. 16 (WP25)

There is a small tributary of Weed Creek at this location, but only a small wetland area was observed. The surrounding vegetation is either pasture or deciduous treed vegetation.
Site 18: Peatland Area North of Itaska Village (WP09)

There is a small, black spruce dominated bog just north of Itaska Village in SE 28-047-01-W5M and immediately to the south of it. Part of this and surrounding lands has been purchased for conservation purposes by a group of landowners at Itaska Village, the Itaska Audubon Society.

South side of Itaska bog. Trail through bog area.

North side of Itaska bog. Upper canopy of Itaska bog.
Site 19: Tributary of Sunnybrook Creek, South of Hwy. 616 (WP85)

This small creek crossed by Hwy. 616, is a tributary to Sunnybrook Creek, to the north. The vegetation on the north is fields with blocks and shelterbelts of poplar/aspen. On the south of the highway, is a relatively young mainly deciduous forest (balsam poplar/trembling aspen), with a few white spruce and jack pine (in higher, sandy areas). The watercourse is very minor, and was barely visible at this point.

Pasture land to the north of Hwy. 616, at site 19 (WP85).

Deciduous vegetation to the south of Hwy. 616, at site 19 (WP85).

Site 20: NW Corner of Study Area (WPNW-96)

At the northwest corner of the ASP area, there is a small creek crossing. The surrounding land is mostly pasture, with shelterbelts and small patches of deciduous trees. However, there are mixedwood patches containing some spruce, associated with the creek.

Mixedwood patches to the south of WP96.

Waypoint 96.
Site 21: High Elevation (WP166)

This is at one of the higher elevations in the study area. The surrounding land is rolling, with mostly pasture, shelterbelts and small patches of deciduous trees. However, there are a few mixedwood patches containing some spruce, but dominated by poplar/aspen.

View from WP166.

View from WP166.

Site 22: Hwy. 616 and Hwy. 771 (WP80)

This site, too, is at a relatively high elevation. The road curves along parallel to a small creek, which has a deep gully. An aspen thicket surrounds the creek, in land which otherwise consists of rolling pasture, shelterbelts and small patches of deciduous trees. The creek is a branch of Sunnybrook Creek, which flows north of the study area.

Road runs alongside the creek.

Aspen stand along the side of the creek gully.
Rolling pasture to the east of the creek and road.

**Site 23: Hwy. 616 and Hwy. 778 (WP05)**

This point is at the junction of Range Road 12 and Twp Rd 474 (i.e., Hwy. 616 and Hwy. 778). Sandholm Hall, a service station and store, are located near this intersection.

Looking north along Hwy. 778.  
Looking south along Hwy. 778.  
Looking west along Hwy. 616.  
Looking east, at the gas station.
Site 24: Golden Days (WP01, 02, 181)

Most of the vegetation in and around the Summer Village of Golden Days is deciduous, consisting of balsam poplar, trembling aspen, paper birch, willows and various other shrub and herb vegetation. However, there are planted spruce and other types of trees in the village and area.

Boat launch entrance, Golden Days Summer Village.

Looking west along the shoreline of Pigeon Lake.

Looking east along the shoreline of Pigeon Lake.

VASA village, Golden Days.
Site 25: Itaska Beach (WP184-186)

Like Golden Days, most of the vegetation in and around the Summer Village of Itaska Beach is deciduous, consisting of mature balsam poplar, trembling aspen, paper birch, willows and various other shrub and herb vegetation. However, there are planted spruce and other types of trees in the village and area. Himalayan Balsam was also noted to be abundant along the shoreline.

| Typical section of shoreline road, Itaska Beach. | Boat ramp. |
| Shoreline, Itaska Beach. | Flower of the non-native, invading plant species Himalayan Balsam. |
| Submergent aquatic vegetation at shoreline, Itaska Beach. |
Like the other villages along the shore of Pigeon Lake, most of the vegetation in and around Sundance Beach is either planted exotics or natural deciduous, i.e., balsam poplar, trembling aspen, paper birch, willows and various other shrub and herb vegetation. The lawns of many properties extend toward the lakeshore beyond the lakeshore road, and in many cases, encroach on the natural shoreline vegetation. Here, too, abundant Himalayan Balsam was noted along the shoreline.

Site 26: Sundance Beach (WP192-195)

Like the other villages along the shore of Pigeon Lake, most of the vegetation in and around Sundance Beach is either planted exotics or natural deciduous, i.e., balsam poplar, trembling aspen, paper birch, willows and various other shrub and herb vegetation. The lawns of many properties extend toward the lakeshore beyond the lakeshore road, and in many cases, encroach on the natural shoreline vegetation. Here, too, abundant Himalayan Balsam was noted along the shoreline.
Site 27: Mission Beach (WP196-199)

Similar to the other villages along the shore of Pigeon Lake, most of the vegetation in and around Sundance Beach is either planted exotics or natural deciduous, i.e., balsam poplar, trembling aspen, paper birch, willows and various other shrub and herb vegetation. The lawns of many properties here, too, extend toward the lakeshore. Rundle’s Mission is located just to the west of the Mission Beach village. The property is located in mainly deciduous forest (aspen/poplar/birch), but with some white spruce.
The land on quarter section SE 23-047-2-W5M was visited on September 18, 2009. It lies just west of Hwy. 771 and about 800 m south of Twp. Road 474. The landowner and resident there is Mr. Bill Wood.

There are two mixedwood stands on the property, as well as peatland at the north and south ends of it. The northeast block of trees consists of mature white spruce, balsam poplar and trembling aspen, with a few pine trees at the east side of the block. The poplar measured up to about 30 cm DBH; with the spruce being up to about 45 cm DBH. There were a lot of fallen spruce and poplar trees observed, with some showing signs of past and recent stem breakage. Mr. Wood commented that he thought some trees had come down during the storm that occurred in the Edmonton area in August, 2009. The forest floor was composed mainly of leaf litter, with many deadfalls. Ground vegetation included bunchberry, false star-flowered Solomon’s seal, coltsfoot, Canada anemone, wild strawberry, wintergreen, wild raspberry, baneberry, creamy peavine, Lindleys’ aster and Northern bedstraw. The floor was mainly of dry leaf litter, but some areas had moss cover.

At the north edge of the stand, the land descends in elevation toward the north. This composes a “trough” oriented east-west which supports a fen complex.

The small stand of mature balsam poplar / white spruce south of the above stand in quarter section SE 23-047-2-W5M (Wood property) is similar to the one described above, although there are some paper birch trees, and patches of almost completely mature white spruce. A small amount of cattle damage was evident, on the south side near the farmhouse and barn area.
South edge of mixedwood stand on northeast of Wood property, looking east toward highway (WP132).

Aspen and white spruce trees near south edge of mixedwood stand (WP132).

Mature spruce trees in south part of mixedwood stand (WP312).

Recently broken trees in mixedwood stand (WP312).

Ground vegetation in mixed stand (WP312).

Upper canopy in mixedwood stand (WP312).
Black spruce dominated forest north of mixedwood stand in northwest of Wood property (WP313).

Black spruce dominated forest north of mixedwood stand (WP314).

Black spruce and larch dominated forest north of mixedwood stand (WP315).

Further north, transition from black spruce/larch forest to willow-birch dominated (WP315).

Transition from black spruce/larch forest to willow-birch dominated (WP315).

Willow-birch dominated community (WP315).
The small stand of mature balsam poplar / white spruce on north side of farmhouse, Wood property.

Site 29: Zeiner Campground (Pigeon Lake Provincial Park) (WP206-207)

The Zeiner Campground, on the northwest shore of Pigeon Lake, is surrounded in forest of mature white spruce, balsam poplar, trembling aspen and white birch.

Lakeshore vegetation at the beach on Pigeon Lake included bulrushes, arrowhead, pondweed and other emergent plants. There were signs of eutrophication due to over-enrichment by nutrients containing nitrogen and phosphorus. Dead or dying aquatic vegetation was observed around the shoreline, and there was ample sign of the invasive weedy species Himalayan Balsam. Invasive plants observed at the south end of the beach at Zeiner Campground included fireweed, sweet-scented chamomile, thistles, nettles, sow thistle, tansyweed, common plantain and dandelions.
The beach at Zeiner Campground.

Aquatic vegetation at shoreline, Zeiner Campground.

Emergent vegetation at south end of beach at Zeiner Campground.

Invasive weedy plants at south end of beach at Zeiner Campground.

Emergent vegetation (bulrushes) at south end of beach at Zeiner Campground.
Site 30: High Elevation Point on RR15 (WP19)

This point is south of the junction of Range Road 15 and Twp Rd 480. From here the land slopes down to the south and the shore of Pigeon Lake. To the east is a ranch that keeps 800 head of buffalo. The surrounding land is mainly pasture, with shelterbelts.

Range Road 15, looking south, Pigeon Lake in distance.  
Looking toward the NE, from WP19.  
Looking toward the NW, from WP19.
3.6.5 Summary of Observations on Vegetation

The following should be considered as particularly sensitive areas with respect to vegetation, water table, and wildlife habitat:

- The Tide Creek riparian areas and associated peatlands;
- The riparian areas and associated peatlands of tributaries 1, 2 and 3 of Tide Creek;
- Deciduous forest and wetland at Leduc Fish & Game Association Lot NE 30-047-01-W5M;
- Deciduous forest, spruce bog and wetland at Hutchinson / Conservation Easement Lot SE 25-047-02-W5M;
- Peatlands in the SW 23-047-02-5 area; and
- The deciduous forest and coniferous forest within Strawberry Creek Natural Area in the south half of the Section 29-047-02-W5M.

Along the shore of Pigeon Lake, there were signs of eutrophication due to over-enrichment by nutrients containing nitrogen and phosphorus. Dead or dying aquatic vegetation was observed around the shoreline, and there was ample sign of invasive weedy species. Invasive plants observed at the beach at Zeiner Campground, for example, included fireweed, sweet-scented chamomile, thistles, nettles, sow thistle, tansyweed, common plantain and dandelions.

The abundance of the non-native, invading plant species Himalayan Balsam is to be noted, occurring mainly on the shoreline but also into the surrounding forest vegetation to some extent.

A list of plant species is shown in Appendix A, which gives the results of four years of plant surveys (2002-2005) done through the Nature Conservancy of Canada on the G&M Hutchinson Conservation Easement at SE 25-047-02-W5M, just north of Mission Beach (C. Hoy and J. Hilson, 2006). The list provides species names for all plants observed in marsh, black spruce bog, birch forest, aspen and poplar forest plant communities.
3.7 WILDLIFE AND WILDLIFE HABITAT

3.7.1 Wildlife Habitat and Biodiversity

Because shallow, marshy areas are scarce, Pigeon Lake and its shores provide only moderately good waterfowl nesting and rearing habitat. During the fall, however, waterfowl use Pigeon Lake and its shore areas as staging area during fall migration (Hardy Associates Ltd., 1983). Colonies of gulls and terns have been reported nesting there, as well as a Great Blue Heron colony in Pigeon Lake Provincial Park (Aquality, 2008).

Based on the presence of a variety of habitat types of substantial size, i.e., mainly deciduous forest, mixedwood forest, mainly coniferous forest, wooded fens/bogs, and marshes, a high diversity of songbirds and some raptor species might be expected in the North Pigeon Lake ASP zone. Even the small woodlots and shelterbelts such as exist in the ASP area are important for migratory songbirds, in that they provide both food and cover during migration periods. Clay-coloured, Song and Savannah Sparrows could be associated with the shrub communities, edges, and adjacent grassland, along with Cedar Waxwings and Orange-crowned Warblers. American Robins, Least and Alder Flycatchers, and Tennessee Warblers could be expected to inhabit the tall shrub/mid-canopy layer, while Warbling and Red-eyed Vireos might be found in the upper canopy of treed areas. Swainson’s Thrushes and Veerys may occur in the lower canopy areas. Snags and deadfalls provide food and/or habitat for various birds and insects, including woodpeckers and secondary cavity nesters like Mountain Bluebirds, Red-breasted and White-breasted Nuthatches, Black-capped Chickadees, House Wrens, Tree Swallows, Northern Flickers, Kestrels and other species that use cavities created by woodpeckers. Yellow warblers would be expected to occur in the willow/tall shrub areas around some of the fen or bog areas and Brown-headed Cowbirds that commonly use nests of Yellow Warblers to lay their eggs could be found in the edges and the forested areas.

In the spruce/aspen or poplar/aspen wooded areas that were observed in August-September 2009, there were fairly numerous snags and downed trees that would provide good foraging habitat for woodpeckers. It is likely that Great Horned and Great Grey Owls would inhabit such areas. It is also likely that with the number of tall poplar or aspen trees, raptors such as the Red-tailed Hawk may nest in the area. In addition, raptors such as Merlins, Sharp-shinned, Cooper’s, or Goshawks have a potential to inhabit the site.

A list of bird species that might be expected to frequent or breed on the North Pigeon Lake ASP area, is given in Table 3.3.
Another list of bird species is shown in Appendix A, this one resulting from five seasons of bird and other wildlife surveys (2001-2006) done through the Nature Conservancy of Canada on the G&M Hutchinson Conservation Easement at SE 25-047-02-W5M, just north of Mission Beach (C. Hoy and J. Hilson, 2006). The lists for the years 2001, 2002, 2003, 2004 and 2006 provide counts for birds, ungulates, rodents and lagomorphs, reptiles and amphibians and insects, as determined from visual, call, sign and track information. Overall, thirty-five species of birds were identified from the area.

Ungulates including whitetail deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*) and moose (*Alces alces L.*), are frequently observed in the North Pigeon Lake ASP area. Elk are heard and seen especially in the wooded areas associated with Tide Creek and its tributaries to the north of Tide Creek. Beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*) and mink (*Neovison vison*) in addition to 135 bird species, including exotic upland game species, have been reported in the Battle River watershed, including the vicinity of Pigeon Lake (Pigeon Lake Study Group, 1975).

There are many white-tailed deer in the area, and these are frequently observed by property occupants. During the field reconnaissance, many white-tailed deer were observed, particularly in the wooded areas associated with Tide Creek and its tributaries to the north of Tide Creek. Signs of moose were also observed in these
areas. According to Mr. Bill Wood, the deer are most abundantly visible when there is hay or other edible crops in the fields. He has seen up to thirty or forty deer on the property at once. Mr. Wood also said that he has seen moose (about 3 times per year) and the occasional black bear frequenting his property, which is located just north of Tide Creek and immediately west of Hwy. 771. He stated that he had noted elk in the area around Tide Creek and north of it, for the last 5-10 years. In the summer of 2009 thus far, he had seen five elk on the north part of his property (Mr. Bill Wood, pers. comm., September 18, 2009). Mr. Tom Cliff also said that elk inhabited the area between Hwy. 616 and Hwy. 616X in Range 02 (Mr. Tom Cliff, pers. comm., September 11, 2009).

Both Mr. Wood and Mr. Cliff commented on the role of beavers in surface water flows in the past and present. They both suggested that, while the beavers alter a lot of the surrounding forest land, their damming activities tend to maintain a certain amount of water in the riverine system, supporting the water table, rather than simply flowing unimpeded out to the Lake and leaving the creek channels dry. Mr. Cliff observed that watercourses like Tide Creek used to hold water, and support the water table, but now this isn’t happening. There may be some point, therefore, in re-examining the County policy of destroying beaver dams and discouraging beavers from establishing them.

Mr. Wood also said that they had seen the tracks of cougar on the property. He has seen woodpeckers of various species, including the Pileated Woodpecker, and various species of owls and hawks on the property. He said that ungulates are most abundant in the large block of forest to the south and southwest of his property, and in the block on the north of his property. They move back and forth across Hwy 771, and along the wooded area along the north side of Tide Creek. They also move to the adjacent forested areas to the east, along the shore of Pigeon Lake.

Mr. Cliff recounted that there seemed to be more racoons and foxes now than in past decades, while there appeared to be fewer coyotes. Also, it seemed that Canada geese are more abundant than in former years, perhaps because they can use the Genesee power plant as resting habitat, then come to farm fields to feed on green shoots.

Based on observations and experience in biophysical assessments in similar ecological situations, as well as discussions with various landowners, common wildlife species that might be expected to inhabit or use the property include: white-tailed/mule deer, moose, snowshoe hare, white-tailed jackrabbit, weasels, red squirrel, thirteen-lined ground squirrel, least chipmunk, porcupine, coyote, black bear (occasional), and various small mammals, including bats. Most of these animals would be likely to use the larger wooded areas as they provide visual shelter, thermal shelter, nesting and denning habitat, as well as browsing and foraging opportunities. Red squirrel warrens were observed in forest areas in which there were mature white spruce trees.

Due to the presence of some surface water for at least part of the year in the various low-lying wet areas of the ASP zone, especially along the creek riparian areas and sloughs, several common species of amphibians are likely to be present on the site. This could include boreal chorus frog, wood frog, Canada toad, and tiger salamander.

In the above mentioned study done through the Nature Conservancy of Canada on the G&M Hutchinson Conservation Easement (C. Hoy and J. Hilson, 2006), the following
animal species were observed: white-tailed deer, moose, beaver, mouse, northern pocket gopher, red squirrel, wood frog and swallowtail butterfly.

Along the north side of Tide Creek, and east of Range Road 22, is the George and Joan Mitchell Memorial Property, which was established by the Alberta Fish and Game Association (AFGA) under its Wildlife Trust Fund, and in collaboration with Alberta Sustainable Resource Development (ASRD). Further west, on the west side of Range Road 22, is the Alberta Fish and Game Association Pigeon Lake property, which includes a portion of the Tide Creek riparian and wooded upland zone. The two areas were originally purchased in order to enhance fish habitat in Tide Creek, by managing the riparian areas near its mouth on Pigeon Lake. This part of the Creek represents good spawning habitat for walleye, Northern pike and suckers. The AFGA worked with ASRD to put in enhanced spawning beds on the properties, bringing in gravel and creating a weir, to encourage fish spawning. AFGA manages the upland habitat of the two areas for a number of ungulate species, including moose, deer and elk. Black bears also take advantage of these spawning areas, catching fish in the Creek.

According to Mr. Brad Fenson of the AFGA, there are deer, moose, elk, black bears, bald eagles and osprey, as well as a variety of raptors that frequent the area. Overall, there is a high diversity of wildlife in the riparian and upland areas of the AFGA properties. Deer and moose frequent the hayfield on the north side of the Memorial property, and generally move back and forth from Creek to the wooded area on the north side of Mr. Bill Wood’s property.

There is significant waterfowl nesting activity in Tide Creek and the surrounding riparian area near the outlet to Pigeon Lake (pers. comm., Mr. Brad Fenson, AFGA).

AFGA has a haying operation on the north and west part of the Memorial property, to increase the protein intake of ungulates in their winter forage.

### 3.7.2 Habitat Fragmentation and Ecological Connectivity

Habitat can be thought of as existing in the form of habitat patches, which vary in size and shape, as well as vegetation composition. Habitat patches serve as sources of food, shelter and other resources on a short-term or long-term basis, as well as permeable habitat for movement. **Ecological connectivity** is the degree to which plants or animals can disperse through and among habitat patches. Several components of connectivity are recognized. These include: core areas; habitat patches; and linkages. Core areas are habitat patches that are large enough to support abundant, stable populations. Large core areas typically contain a higher diversity of wildlife and plant species than do smaller habitat patches. Linkages can be in the form of **stepping stones or corridors**. **Stepping stones** are composed of relatively small patches that are close enough together to facilitate movement among them. As well as linear shaped forest patches, corridors can be in the form of watercourses, utility corridors, transportation rights-of-way, naturalized storm water management facilities, and so forth.

Linkages can be differentiated into higher or lower resistance: for example, higher traffic levels, higher levels of human activity and denser building infrastructure would confer a higher resistance to movement, i.e., less **permeability**. **Fragmentation** is the degree to which large core habitats are broken up into smaller patches by land clearing for agriculture, urban developments, linear facilities and so forth.
Wooded areas are critical to maintaining ecological connectivity in the Dry Mixedwood Forest sub-region, particularly where much of the land has been broken into cultivated lands or pasture. Such areas provide visual and thermal shelter, as well as diverse denning/nesting habitat opportunities, and food in the form of plants or the animals that consume plants.

The largest blocks of relatively unfragmented forest in the North Pigeon Lake ASP area are of sufficient size to maintain many of the ecological functions characteristic of poplar/aspen or spruce/aspen forests in the Dry Mixed-wood Ecological Sub-Region. Other blocks, however, may be too small to serve as a “core” area of habitat that is important to interior forest species. Some bird species, such as American Redstart and Hermit Thrush, require very large contiguous wooded areas for their life cycle requirements, and some forest blocks might be too small for their use. Bird species such as Least Flycatcher, Cedar Waxwing, Black-capped Chickadee and Red-eyed Vireo, however, require a minimum patch size of only about 0.2 ha, and would be likely to inhabit a greater range in block size.

From the observations made in the field reconnaissance (August-September, 2009), study of vegetation and other maps, and discussions with residents of the area, it would appear that the largest and least fragmented blocks of wooded areas are as follows:

1. Along the north side (and further west, the south side) of Tide Creek, which extends west from Pigeon Lake to the west end of the ASP area. This area contains mainly deciduous, mainly coniferous (white spruce, as well as jack pine) and wooded peatland habitats, as well as some scattered wetlands, many of which are initiated by beaver damming.

2. Along the eastern tributary of Tide Creek, which extends about 5 km from near the mouth of Tide Creek, to Hwy. 616 in the northwest. It contains mainly treed fen and mixedwood (white spruce/aspen) forest in the southeast, and transitions to deciduous forest with progression northwest.

3. Along the western tributary of Tide Creek, which extends to the northwest across Twp. Road 474. While it contains patches of mixedwood or mainly coniferous forest, its wooded areas are largely deciduous. This area contains the Strawberry Creek Natural Area.

4. A band of mainly deciduous forest peripheral to the north shore of Pigeon Lake from Zeiner Campground to the southern part of Itaska Beach. Aside from the summer villages and associated residences around the shore of the Lake, this area contains several dedicated lands, i.e., Rundle’s Mission, the G&M Hutchinson Conservation Easement (SE 25-047-02-W5M) and the Leduc Fish & Game Association’s lot of 122 acres (NE 30-047-01-W5M), as well as a bog/fen and associated deciduous forest at Itaska Beach sponsored by the Itaska Audubon Society.

5. A large, relatively unfragmented block of mainly deciduous forest near the centre of the ASP planning area, which merges into the forest around Creek A.
Table 3.3: Common and scientific names of birds observed/expected to breed or otherwise use the North Pigeon Lake ASP area.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada Goose</td>
<td><em>Branta canadensis</em></td>
</tr>
<tr>
<td>Gadwall</td>
<td><em>Anas strepera</em></td>
</tr>
<tr>
<td>American Widgeon</td>
<td><em>Anas americana</em></td>
</tr>
<tr>
<td>Mallard</td>
<td><em>Anas platyrhynchos</em></td>
</tr>
<tr>
<td>Blue-winged Teal</td>
<td><em>Anas discors</em></td>
</tr>
<tr>
<td>Northern Shoveler</td>
<td><em>Anas clypeata</em></td>
</tr>
<tr>
<td>Green-winged Teal</td>
<td><em>Anas crecca</em></td>
</tr>
<tr>
<td>Bufflehead</td>
<td><em>Bucephala albeola</em></td>
</tr>
<tr>
<td>Common Goldeneye</td>
<td><em>Bucephala clangula</em></td>
</tr>
<tr>
<td>Common Merganser</td>
<td><em>Mergus merganser</em></td>
</tr>
<tr>
<td>Gray Partridge</td>
<td><em>Perix perdix</em></td>
</tr>
<tr>
<td>Ring-necked Pheasant</td>
<td><em>Phasianus colchicus</em></td>
</tr>
<tr>
<td>Ruffed Grouse</td>
<td><em>Bonasa umbellus</em></td>
</tr>
<tr>
<td>Solitary Sandpiper</td>
<td><em>Tringa solitaria</em></td>
</tr>
<tr>
<td>Great Blue Heron</td>
<td><em>Ardea herodias</em></td>
</tr>
<tr>
<td>Merlin</td>
<td><em>Falco columbarius</em></td>
</tr>
<tr>
<td>Sharp-shinned Hawk</td>
<td><em>Accipiter striatus</em></td>
</tr>
<tr>
<td>Cooper’s Hawk</td>
<td><em>Accipiter cooperi</em></td>
</tr>
<tr>
<td>Northern Goshawk</td>
<td><em>Accipiter gentilis</em></td>
</tr>
<tr>
<td>Swainson’s Hawk</td>
<td><em>Buteo swainsoni</em></td>
</tr>
<tr>
<td>Red-tailed Hawk</td>
<td><em>Buteo jamaicensis</em></td>
</tr>
<tr>
<td>American Kestrel</td>
<td><em>Falco sparverius</em></td>
</tr>
<tr>
<td>Great Horned Owl</td>
<td><em>Bubo virginianus</em></td>
</tr>
<tr>
<td>Long-eared Owl</td>
<td><em>Asio otus</em></td>
</tr>
<tr>
<td>Northern Saw-whet</td>
<td><em>Aegolius acadicus</em></td>
</tr>
<tr>
<td>Ruby-throated Hummingbird</td>
<td><em>Archilochus colubris</em></td>
</tr>
<tr>
<td>Belted Kingfisher</td>
<td><em>Ceryle alcyon</em></td>
</tr>
<tr>
<td>Yellow-bellied Sapsucker</td>
<td><em>Sphyrapicus varius</em></td>
</tr>
<tr>
<td>Downy Woodpecker</td>
<td><em>Picoides pubescens</em></td>
</tr>
<tr>
<td>Hairy Woodpecker</td>
<td><em>Picoides villosus</em></td>
</tr>
<tr>
<td>Northern Flicker</td>
<td><em>Colaptes auratus</em></td>
</tr>
<tr>
<td>Pileated Woodpecker</td>
<td><em>Dryocopus pileatus</em></td>
</tr>
<tr>
<td>Olive-sided Flycatcher</td>
<td><em>Contopus cooperi</em></td>
</tr>
<tr>
<td>Western Wood-Pewee</td>
<td><em>Contopus sordidulus</em></td>
</tr>
<tr>
<td>Alder Flycatcher</td>
<td><em>Epidonax alnorum</em></td>
</tr>
<tr>
<td>Least Flycatcher</td>
<td><em>Epidonax minimus</em></td>
</tr>
<tr>
<td>Eastern Phoebe</td>
<td><em>Sayornis phoebe</em></td>
</tr>
<tr>
<td>Eastern Kingbird</td>
<td><em>Tyrannus tyrannus</em></td>
</tr>
<tr>
<td>Northern Shrike</td>
<td><em>Lanius excubitor</em></td>
</tr>
<tr>
<td>Warbling Vireo</td>
<td><em>Vireo gilvus</em></td>
</tr>
<tr>
<td>Philadelphia Vireo</td>
<td><em>Vireo philadelphicus</em></td>
</tr>
<tr>
<td>Red-eyed Vireo</td>
<td><em>Vireo olivaceus</em></td>
</tr>
<tr>
<td>Blue Jay</td>
<td><em>Cyanocitta cristata</em></td>
</tr>
<tr>
<td>Black-billed Magpie</td>
<td><em>Pica pica</em></td>
</tr>
<tr>
<td>American Crow</td>
<td><em>Corvus brachyrhynchos</em></td>
</tr>
<tr>
<td>Common Raven</td>
<td><em>Corvus corax</em></td>
</tr>
<tr>
<td>Tree Swallow</td>
<td><em>Tachycineta bicolor</em></td>
</tr>
<tr>
<td>Bank Swallow</td>
<td><em>Riparia riparia</em></td>
</tr>
<tr>
<td>Cliff Swallow</td>
<td><em>Petrochelidon pyrrhona</em></td>
</tr>
<tr>
<td>Barn Swallow</td>
<td><em>Hirundo rustica</em></td>
</tr>
</tbody>
</table>

Expected derived from The Atlas of Breeding Birds of Alberta.
3.8 FISH AND AQUATIC SYSTEMS

3.8.1 Fish and Fish Habitat in Pigeon Lake

Fish species that are known to inhabit Pigeon Lake include walleye (*Stizostedion vitreum*), lake whitefish (*Coregonus clupeaformis*), northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), white sucker (*Catostomus commersoni*), burbot (*Lota lota*), spottail shiner (*Notropis hudsonius*), emerald shiner (*Notropis atherinoides*), trout-perch (*Percopsis omiscomaycus*) and Iowa darter (*Etheostoma exile*). (Aquality, 2008)

Pigeon Lake has been managed for many years, for commercial, recreational and domestic fisheries (Mitchell and Prepas, 1990). There is also significant waterfowl nesting activity in Tide Creek and the surrounding riparian area near the outlet to Pigeon Lake.

Fish populations in Pigeon Lake have fluctuated dramatically over the past century. Human settlement around the lake, increased fishing pressures, and over-fishing during World War II caused lake whitefish, walleye and northern pike populations to collapse. Fish populations have also suffered from habitat loss due to aquatic vegetation removal and shoreline modification and development. While whitefish populations were able to recover; however, walleye disappeared from the lake by the 1960s.

In the 1990s, walleye were successfully re-introduced to Pigeon Lake, but this had the unintended effect of altering the dynamics of the lake’s fish populations. The number, size and fish species available for commercial and recreational anglers changed, and this resulted in conflicts between the lake’s recreational fishers, who prefer walleye, and commercial fishers, who favour whitefish (ASRD, 2008). More detailed analyses of specific fish species population dynamics are treated in Aquality (2008). Further specifics are not discussed here, since they are being covered in other parts of this ASP study series.

Lake Whitefish have been commercially fished for over 80 years. Whitefish spawn on boulder, rubble and sand substrata, which occur on the bottom of Pigeon Lake. Excessive sedimentation by fine silt particles, which can result from erosion, have the effect of smothering eggs by impeding the flow of oxygen amongst the spawning substrate, and this can adversely affect fish reproduction through egg mortality. Thus, there is a direct linkage of whitefish reproduction to erosion and poor land use practices, for example, clearing land and allowing soil to wash into creeks that drain into the Lake, or allowing cattle to trample creek banks.

Because the preferred spawning habitats for northern pike are lakeshore marshes with dense aquatic vegetation, the numbers of these fish have declined due to extensive shoreline development around Pigeon Lake (Kraft and Shirvell, 1974; Aquality, 2008). Habitat loss has occurred due largely to the increase in the number of shoreline properties in the 1960s. The numbers of such cottage and shoreline properties increased steadily from 1950 to 1966, from 250 to 845 cottages, an increase from 6 to nearly 25 cottages per km of shoreline (Bidgood, 1972, as quoted in Aquality, 2008). One of the chief effects of shoreline developments were efforts to remove cattails,
bulrushes and other emergent plants from the shoreline. Although well intended, this resulted in the virtual destruction of important spawning and recruitment habitat for northern pike. It also resulted in the removal of an important mechanism for absorbing nutrients such as nitrogen and phosphorus from the lake water, which otherwise would lead to outbreaks of algae, and to eutrophication.

Northern pike and other predatory fish species are important in controlling prey fish species, which feed on zooplankton, which in turn feed on algae. When such predators become scarce (e.g., though fishing pressure and/or the removal of spawning habitat as described above), the number of smaller, prey fish will tend to increase. With an increase in smaller, zooplankton-eating fish, the numbers of zooplankton will tend to decrease, and as a result, the phytoplankton populations will soar, producing the algal blooms, turbidity and swimmer’s itch that have been experienced over the years on Pigeon Lake (Aquality, 2008).

As can be seen from the above discussion, the introduction of nutrients (e.g., septic tanks, fertilizers and manure) and sediments (from erosion and land management practices), the removal of shoreline vegetation, and fishing pressure, as well as fish stocking efforts, all play a dynamic role in the water quality and aquatic ecology of Pigeon Lake.

3.8.2 Fish and Fish Habitat in Watercourses in the North Pigeon Lake ASP area

The main watercourse in the North Pigeon Lake ASP area is Tide Creek, which drains much of the southwest part of the ASP area, draining toward the east and discharging into the northwest shoreline of Pigeon Lake. The mouth of Tide Creek where it discharges to Pigeon Lake contains good spawning habitat for walleye, Northern pike and suckers. To the south of Twp. Road 474 and east of Range Road 22, is the George and Joan Mitchell Memorial Property, which was established by the Alberta Fish and Game Association (AFGA) under its Wildlife Trust Fund, in collaboration with Alberta Sustainable Resource Development (ASRD). Further west, on the West side of Range Road 22, is the Alberta Fish and Game Association Pigeon Lake property. The two areas were originally purchased in order to enhance fish habitat in Tide Creek, by managing the riparian areas near its mouth on Pigeon Lake. The AFGA worked with ASRD to put in enhanced spawning beds on the properties, bringing in gravel and creating a weir, to encourage fish spawning.

Several other creeks drain the southwest part of the ASP area, flowing southward and draining into Tide Creek (Creek A, Creek B). It is not likely that either of these creeks contain any significant fish population, given their intermittent nature and the number of obstructions caused by beaver dams, coarse woody debris and culverts.

The headwaters of Sunnybrook Creek drain the northwest part of the ASP area, while the headwaters of Weed Creek drain most of the northeast part of the ASP area. Both of these drainage systems eventually enter the North Saskatchewan River drainage system. These two creek systems are small and intermittent, with many blockages, and it is doubtful that they contain any significant fish population.

None of the aforementioned creeks, including Tide Creek, are mapped water bodies under the Alberta Code of Practice for Watercourse Crossings or the Code of Practice for Outfall Structures (Alberta Environment, 2007). This having been stated, the
general requirements for the Codes of Practice under the *Water Act* would need to be followed where any creek is being fitted to a crossing structure such as a culvert.

**Fig. 3.11:** Excerpt from the fish habitat map for the Alberta Code of Practice for Watercourse Crossings and the Code of Practice for Outfall Structures (Alberta Environment, 2007).
3.9 BIODIVERSITY AND RARE SPECIES

3.9.1 Rare and Endangered Species

ANHIC Listed Species

An enquiry was sent to the Alberta Natural History Information Centre (ANHIC), requesting a report as to whether there are records for ANHIC listed species of animal or plant at the site in the North Pigeon Lake ASP study area and within a 2 km (approximately) distance outside of it, specifically, the land defined by:

S2-S6 of Township 48-1-5
S1-6 of Township 48-2-5
S1-2 of Township 48-3-5
S24, 25, 36 of Township 47-3-5
S14 of Township 47-2-5
S19-36 of Township 47-2-5
S14-15 of Township 47-1-5
S23-35 of Township 47-1-5.

The response listed a number of plant and animal species that had been reported. They are shown in Table 3.4 below.
Table 3.4: Listed species that have been reported in the North Pigeon Lake ASP area (+2 km) (ANHIC, 2009).

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Date of report</th>
<th>Location</th>
<th>Provincial Rank</th>
<th>Global Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poanes hobomok</td>
<td>Hobomok Skipper (butterfly)</td>
<td>2000</td>
<td>Pigeon Lake Provincial Park</td>
<td>S2</td>
<td>G5</td>
</tr>
<tr>
<td>Vaccinina optilete</td>
<td>Cranberry blue (vascular plant)</td>
<td>2002</td>
<td>Pigeon Lake, at Itaska Audubon Reserve, in bog, burned over.</td>
<td>S2/S3</td>
<td>G5</td>
</tr>
<tr>
<td>Chiloscyphus pallescens</td>
<td>Liverwort (bryophyte)</td>
<td>2008</td>
<td>Zeiner Campground, behind shower.</td>
<td>S1</td>
<td>G5</td>
</tr>
<tr>
<td>Ricciocarpos natans</td>
<td>Liverwort (bryophyte)</td>
<td>2008</td>
<td>Zeiner Campground, in drainage channel that discharges to Pigeon Lake.</td>
<td>S2</td>
<td>G5</td>
</tr>
<tr>
<td>Ricciocarpos natans</td>
<td>Liverwort (bryophyte)</td>
<td>2008</td>
<td>Zeiner Campground, in open still water and growing on moist mineral soil among Lemna minor along the banks of a wide stream.</td>
<td>S2</td>
<td>G5</td>
</tr>
<tr>
<td>Scapania glaucocephala</td>
<td>Liverwort (bryophyte)</td>
<td>2008</td>
<td>Zeiner Park. In a decaying aspen log in a mixed white-spruce - trembling aspen forest</td>
<td>S2</td>
<td>G4/G5</td>
</tr>
<tr>
<td>Brachythecium rutabulum</td>
<td>Moss (bryophyte)</td>
<td>2008</td>
<td>Zeiner Park. In wood on the forest floor (fallen, decaying bole of willow), in a wet depression dominated by willow.</td>
<td>S2?</td>
<td>G5</td>
</tr>
<tr>
<td>Hypnum pallescens</td>
<td>Moss (bryophyte)</td>
<td>2008</td>
<td>Base of a large white spruce tree in a conifer-dominated forest near the entrance to Zeiner camp.</td>
<td>S2</td>
<td>G5</td>
</tr>
<tr>
<td>Hypnum pallescens</td>
<td>Moss (bryophyte)</td>
<td>2008</td>
<td>Base of several paper birch trees in a mixed trembling aspen, white spruce, paper birch forest adjacent to the Zeiner beach campground.</td>
<td>S2</td>
<td>G5</td>
</tr>
<tr>
<td>Xanthoria fulva</td>
<td>Lichen</td>
<td>2008</td>
<td>Zeiner beach campground: The lichen was growing on poplar bark in an open forested area between two campsites.</td>
<td>S1</td>
<td>G5</td>
</tr>
<tr>
<td>Carex vulpinoidea</td>
<td>Fox sedge</td>
<td>1957</td>
<td>Pigeon Lake; ~3.25 km SW of Mission Beach, near Fisher Home. By lakeshore and low roadside.</td>
<td>S2</td>
<td>G5</td>
</tr>
<tr>
<td>Trichophorum clintonii</td>
<td>Clinton’s bulrush</td>
<td>1999</td>
<td>Strawberry Creek Natural Area (PNT site).</td>
<td>S1</td>
<td>G4</td>
</tr>
<tr>
<td>Trichophorum clintonii</td>
<td>Clinton’s bulrush</td>
<td>2004</td>
<td>Hwy 616; approx 4.5 km S on Rge Rd 24.</td>
<td>S1</td>
<td>G4</td>
</tr>
<tr>
<td>Luzula acuminata</td>
<td>Wood rush</td>
<td>2004</td>
<td>Hwy 616; approx 4.5 km S on Rge Rd 24.</td>
<td>S1</td>
<td>G5</td>
</tr>
<tr>
<td>Ruppia cirrhosa</td>
<td>Widgeon grass</td>
<td>1982</td>
<td>81 transects around Pigeon lake.</td>
<td>S1</td>
<td>G5</td>
</tr>
<tr>
<td>Botrychium michiganense</td>
<td>Grape fern</td>
<td>2004</td>
<td>Hwy 616; approx 4.5 km S on Rge Rd 24.</td>
<td>SU</td>
<td>G1</td>
</tr>
</tbody>
</table>
Sensitive Species

A list of sensitive species whose distribution overlaps the North Pigeon Lake ASP study area, was developed by referencing the system for evaluating the general status of species by Alberta Sustainable Resource Development (Table 3.5). However, many of these species are not likely to occur in the area because of specific habitat requirements and proximity to human development, e.g., Canada Lynx due to human presence and lack of connectivity to its preferred habitat.

Table 3.5:  Sensitive species whose distribution overlaps with the North Pigeon Lake ASP study area.

<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada Toad*</td>
<td>May be at risk</td>
</tr>
<tr>
<td>Red-sided Garter Snake</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Wandering Garter Snake*</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Plains Garter Snake*</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Northern Long-eared Bat</td>
<td>May be at risk</td>
</tr>
<tr>
<td>Thirteen-lined Ground Squirrel</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Long-tailed Weasel</td>
<td>May be at risk</td>
</tr>
<tr>
<td>American Badger</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Canada Lynx*</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Northern Pintail</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Green-winged Teal</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Lesser Scaup</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Horned Grebe</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Great Blue Heron</td>
<td>Sensitive</td>
</tr>
<tr>
<td>American Bittern</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Northern Harrier</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Northern Goshawk</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Broad-winged Hawk*</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Swainson’s Hawk</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Sora</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Black Tern</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Short-eared Owl*</td>
<td>May be at risk</td>
</tr>
<tr>
<td>Pileated Woodpecker</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Least Flycatcher</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Purple Martin</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Barn Swallow</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Eastern Phoebe</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Brown Creeper*</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Sedge Wren*</td>
<td>May be at risk</td>
</tr>
<tr>
<td>Common Yellowthroat</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Baltimore Oriole</td>
<td>Sensitive</td>
</tr>
</tbody>
</table>

*not likely to occur in the area because of habitat requirements. From: The 2005 General Status of Alberta Wild Species.  http://www.srd.gov.ab.ca/fishwildlife/wildspecies/search.htm
3.10 ENVIRONMENTAL AND MUNICIPAL RESERVES, PARKS, TRAILS AND NATURAL AREAS

Pigeon Lake is a popular recreational resource for boating, water-skiing and swimming. The Lake is approximately 22 km long and 11 km wide. There is excellent fishing and bird watching all around its shores. There is, in the vicinity, an abundance of wildlife, golf courses, shopping and a nearby farmers market. Pigeon Lake Provincial Park is located on the northwest shore of Pigeon Lake. The management aim of the Park is to offer a suite of well-treed campsites and provide visitors with a quiet and serene camping experience, as well as the aforementioned recreational opportunities of the immediate vicinity.

The Alberta Fish and Game Association (AFGA) Pigeon Lake Property is located at NE15-47-2-W5M, which is immediately west of Range Road 22. Another AFGA property, named the George and Joan Mitchell Memorial Property, is located immediately to the east of Range Road 22, at NW14-47-to-W5M. In both of these properties, the vegetation consists of mature native shrubs and grasses. Tide Creek runs through the south parts of both of these properties. Species frequenting the AFGA properties include white tailed deer, mule deer, moose, black bear, coyote, beaver, ruffed grouse, snowshoe hare, woodpeckers, many other furbearers and a large variety of bird species (information from AFGA website).

Mission Beach Campground is a small Campground located north of Mission Beach subdivision. Facilities at the site are in poor condition due to vandalism. Mission Beach Day Use Park is a small park located on pigeon Lake within the Mission Beach subdivision. The site provides a swimming area, boat launch, picnicking and children's playground. Most of the facilities at the site are in good condition. The playground is due for replacement in the boat launch has been temporarily closed due to low water levels.

Gilwood Boat Launch is a boat launch in the parking lot located in the Gilwood subdivision. The launch is extremely popular for both launching in the summer, and access to the lake for ice fishing during the winter. Lack of parking space and traffic congestion are the major challenges at this site.

Rundle's Mission, on the north shore of Pigeon Lake, has been described above.

Strawberry Creek Natural Area is a half-section of provincially owned land comprising the south half section of 29-47-2-W5M. Its ecology has been described above.

Waskahegan Trail is a hiking, snowshoeing and cross-country ski trail. The trail is located primarily on private property with agreement of the landowners for use by Trail Association members.

The Hutchinson lot north of Lakeshore Road and south of Twp. Road 474, has been set aside as a Conservation Easement under the Nature Conservancy of Canada (NCC). The NCC is a conservation agency interested in the protection of lands of high conservation value. The intent of the Pigeon Lake project is to protect a variety of ecosystem types (described in detail above) as well as creek watersheds in the northwest corner of the lake as they influence the water quality and fishery of Pigeon Lake.

The Leduc Fish and Game Association has purchased a 122-acre plot of land immediately north of Twp. Road 474A, for conservation purposes (see description under focus site 15, above).
4.0 POTENTIAL ENVIRONMENTAL EFFECTS

4.1 HUMAN ACTIVITIES AND THE NATURAL ENVIRONMENT

4.1.1 Residential Development

The residential population and developments around Pigeon Lake have increased dramatically in the past 4 or 5 decades. Only four summer villages were on Pigeon Lake in the 1960’s, those being Ma-Me-O Beach, Silver Beach, Itaska Beach and Crystal Springs) (Provincial Planning and Advisory Board, 1959). Pigeon Lake Provincial Park was established on the northwest shore of the lake in 1967. At that time, the lakeshore of Pigeon Lake had 22% of its area occupied by developed residential land, with 7% being undeveloped subdivided land, 3% agricultural land, 5%; organizational camps, and 37% privately-owned undeveloped land. The remainder was public park blocks and strips (9.3%), undeveloped crown land (3.7%) and Indian Reserve (13%)(cited from Aquality, 2008).

Since that time, there has been considerable expansion of cottage and residential developments around the lake. At the same time, agricultural developments have steadily increased, both along the shoreline and in the watershed generally. By 1985, the number of private cottages and summer villages around the lake numbered about 2300, and there were ten summer villages and nine hamlets established on its shores (Battle River Regional management Commission 1985). Those within the North Pigeon Lake ASP area include Golden Days, Sundance Beach, Itaska Beach, Mission Beach, Mitchell’s Beach and Gilwood Beach. The most intensive human presence is during the summer, when the summer villages can increase from less than 100 in the winter months to over 2000 during the summer months (Aquality, 2008).

Table 4.1: Population demographics of communities on the shore of Pigeon Lake (Statistics Canada, 2006).

<table>
<thead>
<tr>
<th>Community</th>
<th>Population</th>
<th>Number of dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mulhurst Bay*</td>
<td>313</td>
<td>417</td>
</tr>
<tr>
<td>Golden Days</td>
<td>207</td>
<td>274</td>
</tr>
<tr>
<td>Ma-Me-O Beach</td>
<td>155</td>
<td>232</td>
</tr>
<tr>
<td>Grandview</td>
<td>127</td>
<td>184</td>
</tr>
<tr>
<td>Crystal Springs</td>
<td>112</td>
<td>124</td>
</tr>
<tr>
<td>Mulhurst*</td>
<td>108</td>
<td>159</td>
</tr>
<tr>
<td>Sundance Beach</td>
<td>102</td>
<td>124</td>
</tr>
<tr>
<td>Poplar Bay</td>
<td>84</td>
<td>145</td>
</tr>
<tr>
<td>Argentia Beach</td>
<td>52</td>
<td>90</td>
</tr>
<tr>
<td>Silver Beach</td>
<td>47</td>
<td>35</td>
</tr>
<tr>
<td>Norris Beach</td>
<td>40</td>
<td>76</td>
</tr>
<tr>
<td>Itaska Beach</td>
<td>35</td>
<td>70</td>
</tr>
</tbody>
</table>

Fig. 4.1: Oil and gas pipelines in the North Pigeon Lake ASP area (County of Leduc).
Fig. 4.2A: The current distribution of population in the EAST part of North Pigeon Lake ASP area (red dots indicate human residences). (County of Leduc).
Fig. 4.2B: The current distribution of population in the WEST part of North Pigeon Lake ASP area (red dots indicate human residences). (County of Leduc).
Figs. 4.2A and 4.2B, respectively, show the current distribution of population in the North Pigeon Lake ASP area. The red dots on the maps indicate human residences. It can be seen that much of the population (although much of it seasonal) is around the shore of the Lake.

The major potential outcomes of these human populations around the shoreline include:

- Removal of shoreline aquatic vegetation, which results in loss of fish spawning habitat;
- Introduction of nutrients (phosphorus, nitrogen compounds) into the Lake, resulting from the use of fertilizers in lawns and gardens near the lakeshore;
- Seepage of nutrients from old or faulty septic tank systems.
- Possibility of pathogenic bacteria entering the lake, through faulty septic tank or other waste systems;
- Introduction of weed species to the area.

The numbers of sewage facilities installed since 2000 in the North Pigeon Lake ASP area is shown in Table 4.2 (data from County of Leduc). In all, there were 55 facilities installed in the period, of which 12 (22%) were septic tanks and 43 (78%) were sewage holding tanks. Although the data are few, it appears that over 90% of the facilities installed in the lakeshore communities were sewage holding tanks as opposed to septic tanks with fields. For other locations, septic tanks comprised over 60% of the total.

**Table 4.2: Number of sewage facilities installed since 2000 in the North Pigeon Lake ASP area.**

<table>
<thead>
<tr>
<th>Lakeshore Communities</th>
<th>Septic Tanks/Fields</th>
<th>Holding Tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron Horse Estates</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Kerr Cape Estates</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Mission Beach</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Mitchell Beach</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Moonlight Bay</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Sundance</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>3</strong></td>
<td><strong>38</strong></td>
</tr>
<tr>
<td></td>
<td>7%</td>
<td>93%</td>
</tr>
<tr>
<td>Other Locations</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>64%</td>
<td>36%</td>
</tr>
</tbody>
</table>
4.1.2 Agriculture

Aerial photographs of the North Pigeon Lake ASP area are shown in Appendix D, taken in the years 1949, 1962, 1981 and 2001.

The 1949 imagery shows that some of the land was cleared for agriculture, mainly on the east side of the area. There was relatively very little development or clearing around the shoreline of Pigeon Lake.

By 1962, more of the land north, east and west of the lake had been cleared for farming, and there are signs of oil and gas activity, mainly in the northwest part of the ASP area. Some degree of development around the lakeshore is evident.

By 1981, most of the land sections in the Pigeon Lake watershed were at least partially cultivated for cattle, dairy, and grain production. Agriculture and clearing of forested areas to accommodate it, has expanded considerably since that time.

By 2001, the considerable degree of summer village development around the lakeshore is evident, as well as the large proportion of area cleared for agriculture.

The potential environmental effects resulting from agricultural development include:

- Clearing of forested area, resulting in loss of “core” wildlife habitat and ecological connectivity (fragmentation);
- Loss or alteration of riparian, wetland or peatland communities;
- Introduction of nutrients (phosphorus, nitrogen compounds) into the Lake, resulting from livestock manure which flows either by surface water runoff or by entry into the shallow groundwater and subsequent movement to the Lake;
- Use of chemical fertilizers and pesticides, which may flow via surface or ground water to creeks and the Lake, causing eutrophication or other adverse effects; and
- Increased erosion due to exposure of untreed areas to wind and surface water runoff; resulting in siltation of watercourses and sedimentation in the Lake.

4.1.3 Oil and Gas Production

Oil was discovered in the vicinity of Pigeon Lake in 1947 when the Leduc #1 well was drilled in a field near Leduc. After the Leduc discovery, oil and gas exploration and development increased exponentially, and additional oil fields were discovered. The current density of oil and gas production facilities around Pigeon Lake can be inferred from Fig. 4.1, which shows the project area and the pipelines that exist within it.

It is evident from the map that most of the activity appears to be in the northwest part of the ASP area, and only several pipelines extend south of Twp. Road 474. This means that much of the sensitive peatland and riparian areas along Tide Creek and its tributaries have not been subject to as dense a development regime as the higher, well drained lands further to the north. This has significant implications for the Area.
Structure Plan. Planning efforts should be aimed at minimizing oil and gas development in these more ecologically and hydrologically sensitive zones, and where it is allowed, enhanced protection measures should be required. Establishing pipelines through peatlands in a manner that protects the soils, groundwater and surface water flows, as well as protecting sensitive vegetation communities that constitute important wildlife habitat, is still a developing science.

The potential environmental effects of oil and gas production and related activities include:

- Clearing of forested area for well sites, pipelines, seismic lines and access routes, resulting in fragmentation of wildlife habitat;
- Alteration or degradation of riparian, wetland or peatland communities, related to clearing treed areas or road/pipeline crossings of peatlands and watercourses;
- Potential for soil and groundwater contamination, due to spilled or buried materials (e.g., crude oil, salt water, drilling muds, related chemicals used);
- Increased erosion due to access roads, watercourse crossings, well sites where vegetation has been cleared to allow development.

4.1.4 Recreation

There are a number of recreational activities and facilities that are available to residents and visitors of Pigeon Lake and surrounding lands, including swimming, camping, fishing (summer and winter), boating (sailing, kayaking, power boating), wind surfing, wildlife viewing, hiking, and cross-country skiing.

The most significant recreational facilities are summer camps (e.g., Camp Muskepetoon, Camp Wohelo), golf courses, camping and day-use areas (e.g., Zeiner Campground) (Aquality, 2008).

The development has increased substantially around the lake from 1987 to 2000, especially on the northern shore of the lake. Together, recreational activities increase the population in the vicinity of Pigeon Lake about 200 to 220-fold compared to the permanent population of the ten largest communities on the lake (about 1000) (Aquality, 2008).

The resulting environmental effects would be similar, in effect, to those listed above for residential.
4.2 DISCUSSION OF ENVIRONMENTAL EFFECTS

4.2.1 Aquatic Ecosystems

As discussed above, residential, agricultural and other human activities have the potential for greatly increasing nutrient inputs into Pigeon Lake. This has largely to do with land management practices, sewage and manure management around the lake. The loss of aquatic submergent and emergent plants around the shores that constitute fish spawning habitat is an additional concern. These riparian areas act as a filter for removal of excess nutrients. The effect of excessive nutrient inputs is the production of algal blooms, the de-oxygenation of water when the excess algae die and are decomposed by micro-organisms, and eventually the death of fish as a result. While some measures exist to reduce the levels of phosphorus post facto, including water column aeration or the addition of chemical immobilizers such as iron, calcium and aluminum salts, these approaches provide only short-term fixes. The solution lies in reducing the amounts of such substances at source, i.e., manure management, control of livestock operations near the Lake, removal/repair of septic tanks, development of a common sewerage and treatment system for human waste, and restriction of the use of chemical fertilizers near the lakeshore.

Nutrient over-enrichment and resulting algal blooms can also be reduced by effectively managing the fishery in the Lake. Fish reproduction varies highly among years, and a high recruitment can produce fluctuations in lower trophic levels at time scales of years to decades (Aquality, 2008). This is because certain fish specialize in consuming zooplankton, which in turn consume algae in the water. When such fish are subjected to heavy predation by introduced or other fish predator species, zooplankton numbers rise and algal populations decrease. Conversely, when plankton-eating fish populations are greater, then zooplankton numbers fall and algal populations increase.

If nutrients are at elevated levels during the latter periods, this can act as a combined set of factors that leads to algal blooms. Furthermore, if oxygen levels in the Lake become low due to the decomposition of algal cells, the chemical changes so induced are capable of releasing phosphorus that had been locked up in the sediments of the Lake, thus aggravating and extending the algal bloom and causing a positive feedback loop that leads to very poor ecological health in the Lake.

Erosion, with resulting siltation and sedimentation of water bodies also has a detrimental effect on aquatic ecosystems such as Pigeon Lake. As discussed earlier in this report, sedimentation can cause smothering of fish eggs in the lake substrate, and as a result lower reproductive success in fish populations.

4.2.2 Loss/Degradation of Sensitive Vegetation Communities and Wildlife Habitat

As discussed above, it can be seen from historical aerial photographs that a great deal of forested land has been lost due to clearing for agricultural, industrial or residential purposes. The "core" wildlife habitats that once existed (e.g., see aerial photograph of 1949) have been significantly fragmented. While some peatland has been lost, there is still a substantial area that has remained more or less intact. This includes the
riparian area of Tide Creek and its tributaries, including an area to the west of Zeiner Campground which extends west to and beyond Range Road 22. There is also a peatland area near Itaska Beach. These peatland areas need protection not only from direct loss and fragmentation but also from declining water tables.

The following should be considered as particularly sensitive areas with respect to vegetation, water table, and wildlife habitat:

- The riparian areas along Tide Creek and associated wetlands and peatlands;
- The riparian areas and associated peatlands of tributaries north of Tide Creek;
- Deciduous forest and wetland at Leduc Fish & Game Association Lot NE 30-047-01-W5M;
- Deciduous forest, spruce bog and wetland at Hutchinson Conservation Easement Lot SE 25-047-02-W5M;
- Peatlands in Section 23-047-02-W5M, north of Tide Creek, which extend across Hwy. 771, westward across Range Road 22 and further to the west;
- Fen/bog habitat just north of Itaska Village in SE 28-047-01-W5M and immediately to the south of it; and
- The deciduous forest and coniferous forest within Strawberry Creek Natural Area in the south half of the Section 29-047-02-W5M.

Along the shore of Pigeon Lake, there were signs of eutrophication due to over-enrichment by nutrients containing nitrogen and phosphorus. Dead or dying aquatic vegetation was observed around the shoreline, and there was ample sign of invasive weedy species. Invasive plants observed at the beach at Zeiner Campground, for example, included fireweed, sweet-scented chamomile, thistles, nettles, sow thistle, tansyweed, common plantain and dandelions.

The abundance of the non-native, invading plant species Himalayan Balsam is to be noted, occurring mainly on the shoreline but also into the surrounding forest vegetation and creek channels to some extent.

4.2.3 Fragmentation and Loss of Core Habitats

Wooded areas are critical to maintaining ecological connectivity in the Dry Mixedwood Forest sub-region, particularly where much of the land has been broken into cultivated lands or pasture. Such areas provide visual and thermal shelter, as well as diverse denning/nesting habitat opportunities, and food in the form of plants or the animals that consume plants.

The largest blocks of relatively unfragmented forest in the North Pigeon Lake ASP area are of sufficient size to maintain many of the ecological functions characteristic of poplar/aspen or spruce/aspen forests in the Dry Mixed-wood Ecological Sub-Region. Other blocks, however, may be too small to serve as a “core” area of habitat that is important to interior forest species.
From the observations made in the field reconnaissance (August-September, 2009), study of vegetation and other maps, and discussions with residents of the area, it would appear that the largest and least fragmented blocks of wooded areas are as follows:

1. Along the north side (and further west, the south side) of Tide Creek, which extends west from Pigeon Lake to the west end of the ASP area. This area contains mainly deciduous, mainly coniferous (white spruce, as well as jack pine) and wooded peatland habitats, as well as some scattered wetlands, many of which have been created by beaver damming.

2. Along the tributary of Tide Creek that extends about 5 km from near the mouth of Tide Creek, to Hwy. 616 in the northwest. It contains mainly treed fen and mixedwood (white spruce/aspen) forest in the SE, and transitions to deciduous forest with progression northwest.

3. Along the tributary of Tide Creek that extends to the northwest across Twp. Road 474 at Range Road 24. While it contains patches of mixedwood or mainly coniferous forest, its wooded areas are largely deciduous. This area contains the Strawberry Creek Natural Area.

4. A band of mainly deciduous forest peripheral to the North shore of Pigeon Lake from Zeiner Campground to the southern part of Itaska Beach. Aside from the summer villages and associated residences around the shore of the Lake, this area contains several dedicated lands, i.e., Rundle’s Mission, the G&M Hutchinson Conservation Easement (SE 25-047-02-W5M) and the Leduc Fish & Game Association’s lot of 122 acres (NE 30-047-01-W5M).

5. A large, relatively unfragmented block of mainly deciduous forest near the centre of the ASP planning area, which incorporates the riparian areas of the two tributaries of Tide Creek.
5.0 RECOMMENDATIONS

The following recommendations are put forward in designing the North Pigeon Lake Area Structure Plan (ASP). It is to be noted that many of them were also presented as recommendations in the Pigeon Lake Watershed Management Plan, as well as the Wizard Lake ASP. Recommendations are made for the following environmental values. The recommendations are discussed under (1) General Area Structure Plan Policies; and (2) Conservation of Special Areas.

The former, General Area Structure Plan Policies, are intended as actions that will protect and enhance air, water, soil, vegetation, wildlife and ecosystem health that should apply to any area or activity within the planning area. They are discussed under the following headings:

- General Considerations
- Surface Water Hydrology and Water Quality
- Fish Habitat and Aquatic Ecosystems
- Sensitive Vegetation and Wildlife Habitat
- Ecological Connectivity

The latter, Conservation of Special Areas, sets out recommendations for conserving lands that are either sensitive, i.e., wetlands, peatlands (fens, bogs) and riparian areas; or which represent valuable “core” habitat areas or ecological linkages, which through conservation, will contribute to ecological connectivity and reduce habitat fragmentation. These areas are discussed under:

- Sensitive Vegetation
- Wildlife Habitat and Ecological Connectivity

Such areas could be considered as Environmental Reserves, Municipal Reserves, or Conservation Easements. Environmental Reserves would pertain to lands that have sensitive vegetation, or are susceptible to flooding, erosion or some other type of land instability or environmental hazard.

5.1 GENERAL AREA STRUCTURE PLAN POLICIES

5.1.1 General Considerations

- Avoid or limit development in sensitive areas such as riparian areas, wetlands or peatlands in the ASP area, as outlined in this report.
- Conduct an environmental or biophysical assessment of existing natural features prior to subdivision or development approval. The assessment should provide recommendations as to the means of preserving, protecting or enhancing surface or ground water, vegetation, wildlife habitat, ecological connectivity or other valued ecosystem components and natural features.
- Integrate natural features such as tree stands, streams, etc. as part of the planning of any new residential or other development, to the extent feasible. Assess the requirements for set-back margins based on protection of ecological features.
Adopt the cluster pattern of country residential development, so as to minimize the impact on the natural environment and increase the available land for conservation and natural resource protection.

Adapt the design of residential areas to conform to the existing topography where technically feasible, integrating the development within the landscape, and retaining surface water flow patterns.

Include low-impact pedestrian trails within new residential areas, which integrate with other existing trails in the area. Consider interpretive signage for vegetation, wildlife habitat or other ecological features. Link the trail system with other features in or near the development, such as forest areas or wetlands, but in such a way as not to cause excessive disturbance of wildlife populations or ecologically sensitive areas.

Before any development takes place in new areas, an assessment of potential soil contamination, vegetation damage or other impact stemming from past or current oil and gas production activities should be conducted. In doing this, it should be taken into account that in earlier periods reclamation assessments and requirements may not have been as rigorous as they are today. Soil and/or ground water testing may be necessary in such cases, to ensure that there is no residual contamination.

5.1.2 Surface Water Hydrology and Water Quality

Work towards a municipal sewer system, whereby all lake cottages are served by municipal sewer systems which collect waste water, pipe it to a lagoon, and release the treated effluent downstream from Pigeon Lake. Any new developments should be required to connect into existing treatment systems or to have equivalent treatment.

Ensure that private sewer systems are functioning properly, and eliminate grey water systems (i.e., older properties run bathroom waste through a septic tank and disposal field but allow grey water to flow out untreated).

Eliminate the use of lawn fertilizer on lakeshore property, by means of an education program for residents around the lakeshore.

Improve manure storage and handling systems on lands draining into Pigeon Lake. Control new animal operations by not allowing any new intensive livestock operations on land draining into the Lake, and by using environmental siting requirements (based on Alberta Agriculture construction standards and standards for manure storage and use) to determine the environmental acceptability on a case-by-case basis.

Encourage tree cover and appropriate lot sizing in any new developments. Taking into account constraints such as water supply and the effect on runoff patterns when more land is cleared, as well as the beneficial effects of tree cover. Where site conditions are suitable, development at the 3-5 acre (1.2 – 2 hectares) range of density should be encouraged on tree covered land in the first 1.6 km back from the lake shore.
Preserve and protect peatlands, marshes, other wetland areas and natural springs. When land is being subdivided, groundwater recharge areas should be taken into municipal ownership as environmental reserve. Alternatively, they could be subject to environmental or conservation easements to limit land clearance or drainage. A buffer zone of suitable width should be established around such recharge areas in order to protect them from surrounding developments and activities. No industrial or residential development should be permitted in the buffer zone.

Protect fish habitat by discouraging residents along the lakeshore from removing submersgent and emergent aquatic vegetation (e.g., through an education program, perhaps combined with other issues such as fertilizer use).

Maintain riparian buffers along creeks, streams and other watercourses, particularly along Tide Creek and its tributaries, in order to protect water quality, maintain surface and sub-surface flows, and provide wildlife habitat.

Minimize the number of crossing structures on permanent or intermittent watercourses, following the Alberta Water Act Code of Practice for Watercourse Crossings.

Maintain surface water flows to natural wetlands, streams and peatlands within the range of natural variation.

Develop storm water management plans for new developments in such a way as to minimize negative impacts to surface water bodies, watercourses, wetlands and peatlands. Consider incorporating bioswales and existing low, wet areas into the stormwater management design.

Consider constructed wetlands as part of the stormwater management design for any new developments, to cleanup stormwater runoff before it enters receiving waters.

Avoid removal of natural vegetation within or adjacent to environmentally sensitive areas such as peatlands, wetlands, riparian and lakeshore areas.

Encourage residents to adopt xeriscaping methods of landscaping, i.e., landscaping with native, drought-tolerant plants to create low-maintenance lawns and gardens; improving the soil with organic matter; establishing trees and shrubs; using mulches applied to the soil surface to reduce evaporation and reduce erosion; and avoiding over-watering and the use of chemical fertilizers. Encourage the use of rain barrels and other water conservation methods.

Encourage residents to use native plants such as shrubby willows or poplars in landscaping. These plants are already adapted to the growing conditions of the region. They are generally more resistant to disease and stresses that introduced plants experience, and this will reduce the need for mowing and having to apply fertilizer, pesticides and extra water. They also help protect soil from erosion and provide natural habitat for wildlife.
5.1.3 Fish Habitat and Aquatic Ecosystems

- Implement ways to reduce the amount of nitrogen and phosphorus nutrients that enter the Lake via leakage from septic tanks, the application of fertilizers, livestock manure and other sources. This could be done through improvements in sewage collection and disposal in the most populated areas, and through improvements or replacement of old septic systems near the shore of the Lake.

- Encourage land management practices that lead to the minimization of silt and other particulates entering the Lake via surface runoff, particularly where there is bare or overgrazed land and soil erosion. Livestock should not be allowed to trample the beds and shores of creeks and other waterbodies.

- Establish and maintain appropriately sized buffer areas along creeks in the planning area, particularly in the southwest part of it and particularly Tide Creek and its tributary creeks. The buffer areas should not permit clearing of forested land, nor construction of built facilities or developments.

- Re-evaluate the County policy of destroying beaver dams and discouraging beavers from establishing them. While the activities of beavers alter flows in drainage systems and alter the surrounding forest, their damming activities tend to maintain a certain amount of water in the riverine system, rather than it simply flushing out to the Lake and leaving the creek channels dry.

- Discourage the removal of submergent and emergent aquatic vegetation along the Lake shore by local residents, since this represents valuable fish spawning habitat, as well as a mechanism for removing excess nutrients from the Lake. Aquatic vegetation around the shoreline fulfills several critical roles in environmental improvement. It stabilizes soil, traps sediment, and protects shorelines from erosion. It also serves to absorb nutrients and toxins, as well as supplying oxygen, all of which enhances the water quality of the lake and can prevent the incidence of algal blooms that result from an excess of nutrients in the water which in turn stem from the use of fertilizers and runoff around the shoreline. Aquatic vegetation also provides nesting sites for birds, habitat for fish, and food for wildlife.

- Discourage the use of fertilizers on properties adjacent to the shore of the Lake, as the addition of nitrogen and phosphorus compounds to the lake via surface runoff can contribute to algal blooms and resulting declines in water quality. This message, as well as the preceding one on aquatic vegetation removal, could be delivered through education programs.

5.1.4 Sensitive Vegetation and Wildlife Habitat

- Sustain the value of existing wildlife habitats in the ASP planning area by maintaining habitat types that are sensitive and contribute to plant and animal biodiversity, such as riparian areas, wetlands, coniferous and deciduous forests and peatlands, as outlined in this report.

- Reclaim or restore disturbed habitats, and re-vegetate with native vegetation where feasible.
• Where development is permitted, minimize the clearing or disturbance of riparian and upland vegetation.

• Eliminate or manage, as feasible, non-native or invasive plant species, to minimize their spread, e.g., Himalayan Balsam.

• Establish buffer areas of appropriate widths around natural areas, sensitive ecosystems and aquatic habitats to reduce impacts to plants and animals.

• Minimize the alteration or development of any peatlands in the ASP planning area, and establish buffers of appropriate width around peatlands to enhance their sustainability (e.g., 30 m outside of the point at which vegetation changes from typical peatland vegetation to typical upland vegetation). Peatlands represent an ecosystem type that is becoming increasingly rare in developed areas of northern Alberta due to direct loss, draining or alterations in the water table, which may result in turn from changed permeability and groundwater recharge, stemming in turn from development.

• In the planning of any new residential areas, create or maintain a diversity of habitats for wildlife (forest patches of different size and shape, wetlands, etc.).

• In the planning of any new residential areas, key in buildings to surrounding trees to maximize bird and other wildlife habitat. However, leave sufficient space between building walls and mature trees to avoid a hazard from falling trees (e.g., one tree-length for mature trees).

• In existing forested areas, leave fallen or standing dead wood (“snags”) as a habitat for woodpeckers and other life forms. However, do not allow snags to pose a safety hazard along trails or near residences, or parking and recreational areas.

• Maintain and enhance riparian areas, peatlands and wetlands to conserve breeding habitat for amphibians. If possible, maintain connectivity among wetland areas to maintain linkages between breeding sites.

• Manage invasive weedy plants such as sweet-scented chamomile, purple loosestrife, pondweed, thistles, nettles, sow thistle, tansyweed, common plantain, Himalayan Balsam and dandelions. This, too, could be incorporated into an educational program for residents of the area.

5.1.5 Ecological Connectivity

• Establish vegetation or other features around developed areas or along roadways, which will serve to assist the movement of wildlife (see discussion earlier in this report about connectivity, dispersion corridors and stepping stones).

• Maintain natural wildlife dispersion corridors by (a) retaining and (b) establishing buffer zones along or around watercourses, wetlands, riparian areas, or mature forest areas (see recommended areas for preservation next section).

• In the design of new residential or other areas, utilize natural vegetation or greenways, utility corridors or storm water management facilities to serve as corridors or "stepping stones" to maintain or enhance ecological connectivity among habitat patches (forested, wetland, riparian or other types of habitat).
5.2 CONSERVATION OF SPECIAL AREAS

5.2.1 Vegetation

The areas listed below should be considered as particularly sensitive areas with respect to vegetation (as well as surface and ground water flows and wildlife habitat). They are indicated in blue shading on Fig. 6.1.

- The riparian areas along Tide Creek and associated wetlands and peatlands;
- The riparian areas and associated peatlands of tributaries of Tide Creek that drain into Tide Creek from the north;
- Deciduous forest and wetland at Leduc Fish & Game Association Lot NE 30-047-01-W5M;
- Deciduous forest, spruce bog and wetland at Hutchinson / Conservation Easement Lot SE 25-047-02-W5M; the land in between the Leduc Fish & Game Association Lot and the Hutchinson / Conservation Easement Lot is highlighted as well, because of the opportunity of affording ecological connectivity, and the creation of a larger, continuous block of forested area.
- Peatlands in Section 23-047-02-W5M, north of Tide Creek, which extend from the lakeshore, west across Hwy. 771 and further west across Range Road 22;
- Fen/bog habitat in SE 28-047-01-W5M and the land immediately to the south (and north of Itaska Beach) part of which is owned by the Itaska Audubon Society; and
- The deciduous forest and coniferous forest within Strawberry Creek Natural Area in the south half of the Section 29-047-02-W5M.

5.2.2 Wildlife Habitat and Ecological Connectivity

From the observations made in the field reconnaissance (August-September, 2009), study of vegetation and other maps, and discussions with residents of the area, it would appear that the largest and least fragmented blocks of wooded areas are as follows:

- Along the north side (and further west, the south side) of Tide Creek, which extends west from Pigeon Lake to the west end of the ASP area. This area contains mainly deciduous, mainly coniferous (white spruce, as well as jack pine) and wooded peatland habitats, as well as some scattered wetlands, many of which are initiated by beaver damming.
- Along the more easterly tributary of Tide Creek that extends about 5 km from near the mouth of Tide Creek, to Hwy. 616 in the northwest. It contains mainly treed fen and mixedwood (white spruce/aspen) forest in the southeast, and transitions to deciduous forest with progression northwest.
• Along the more westerly tributary of Tide Creek that extends to the northwest across Twp. Road 474 at Range Road 24. While it contains patches of mixedwood or mainly coniferous forest, its wooded areas are largely deciduous. This area contains the Strawberry Creek Natural Area.

• A band of mainly deciduous forest peripheral to the North shore of Pigeon Lake from Zeiner Campground to the southern part of Itaska Beach. Aside from the summer villages and associated residences around the shore of the Lake, this area contains several dedicated lands, i.e., Rundle’s Mission, the G&M Hutchinson Conservation Easement (SE 25-047-02-W5M); the Leduc Fish & Game Association’s lot of 122 acres (NE 30-047-01-W5M); and the Itaska Audubon Society’s lands north of Itaska Beach.

• A large, relatively unfragmented block of mainly deciduous forest near the centre of the ASP planning area, which merges into the forest around the eastern of the two tributaries to Tide Creek.

Blocks of continuous forest area that are connected with each other, are relatively undeveloped and larger than 250 ha, are shown in Fig. 6.2.

These relatively unfragmented blocks or corridors of wooded land represent opportunities to conserve interconnected blocks of sufficient size that wildlife will utilize them as “core” habitat areas and/or dispersion corridors, while preserving critical habitats such as wetlands, coniferous forest and peatlands.

Where such blocks are identified and reserved for conservation, they can be defined as areas where no industrial or residential development takes place, or where such developments are modified to low-impact activities. Industrial or residential development should not be allowed within these areas unless it can be proven that the associated impacts are insignificant in respect to water, soil, vegetation, wildlife or ecological sustainability and connectivity.

Fig. 6.3 shows a superimposition of the areas identified above as sensitive plus the large forested blocks. The County should consider purchasing lands situated in critical areas in these corridors/blocks, or between adjacent high-value conservation areas to provide additional ecological connectivity.
Fig. 6.1: Sensitive lands (wetland, peatland and riparian areas) in the North Pigeon Lake ASP area.
Fig. 6.2: Ecological connectivity: major blocks of forested areas in the North Pigeon Lake ASP area.
Fig. 6.3:  Major core blocks of forested area and sensitive areas in the North Pigeon Lake ASP area.
6.0 REFERENCES


13. Leduc County Corporate Goals.

14. Leduc County Land Use Bylaw (LUB).

15. Leduc County Municipal Development Plan (MDP).

16. Leduc County Parks and Open Spaces Master Plan.


7.0 LIMITATIONS

This report has been prepared for the use of Leduc County, Challenger Engineering Ltd., and Dansol Ltd., and its consultants or clients relative to the proposed project described in the report. It may not be used or relied upon in any manner whatsoever, or for any purpose whatsoever, by any other party. The Consultant makes no representation of fact or opinion of any nature whatsoever to any person or entity other than the company, organization or individual to whom this report is addressed.

Bruce Thompson & Associates Inc. denies any liability whatsoever to other parties who may obtain access to this report for any injury, loss or damage suffered by such parties arising from their use of, or reliance upon, this report or any of its contents without the express written consent of the author and the client.

Subject to the following conditions and limitations, the investigation described in this report has been conducted in a manner consistent with a reasonable level of care and skill normally exercised by members of the environmental consulting profession currently practicing under similar conditions in the area.

The investigation described in this report has been limited to the scope of work described in discussions between Challenger Engineering Ltd. and Bruce Thompson & Associates Inc. and the client group during August and September, 2009.

The investigation described in this report has been limited to the extent that the steps of doing a field reconnaissance were done at one time (late summer) of the year (July 29 – September 30). Features such as plants and wildlife, and water flows, are different at different times of the year, and will have variations from season to season and from year to year. To determine the entire assemblage of plants and wildlife that would frequent the study site, it would be necessary to conduct field surveys during the later summer months. The species identified in this study included those that were seen in the field reconnaissance.

The possibility of contamination from past activities on the property, or other public safety risks, were not assessed in this investigation. This would more appropriately fit into the scope of a Phase 1 Environmental Site Assessment.

Consultations were conducted, either in person or by telephone, with people who lived or had property in the North Pigeon Lake ASP area. The people who were spoken to were those whose names had been provided by the County of Leduc as being willing to provide their views. We were somewhat limited by the fact that only about 12 landowners agreed to participate in interviews. Further limitation was experienced in the fact that we could not access many areas of the ASP zone because landowner consent was not offered.
8.0 LIST OF APPENDICES

APPENDIX A: LISTS OF PLANT SPECIES AND WILDLIFE OBSERVED AT THE HUTCHINSON CONSERVATION EASEMENT, 2001-2005

APPENDIX B: WAYPOINT COORDINATES

APPENDIX C: ANHIC REPORT

APPENDIX D: HISTORICAL AERIAL PHOTOGRAPHS